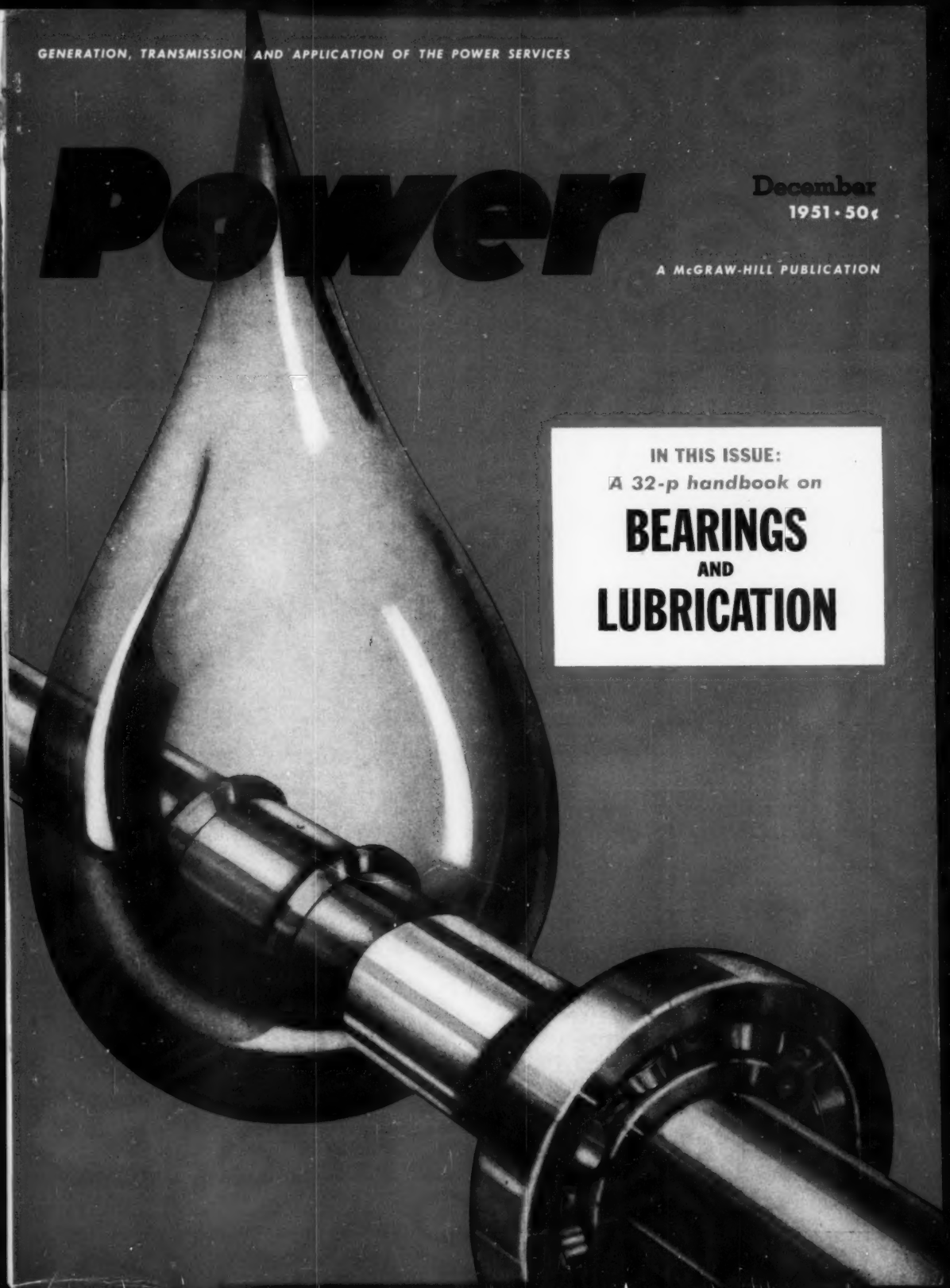
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

Power

December
1951 · 50¢

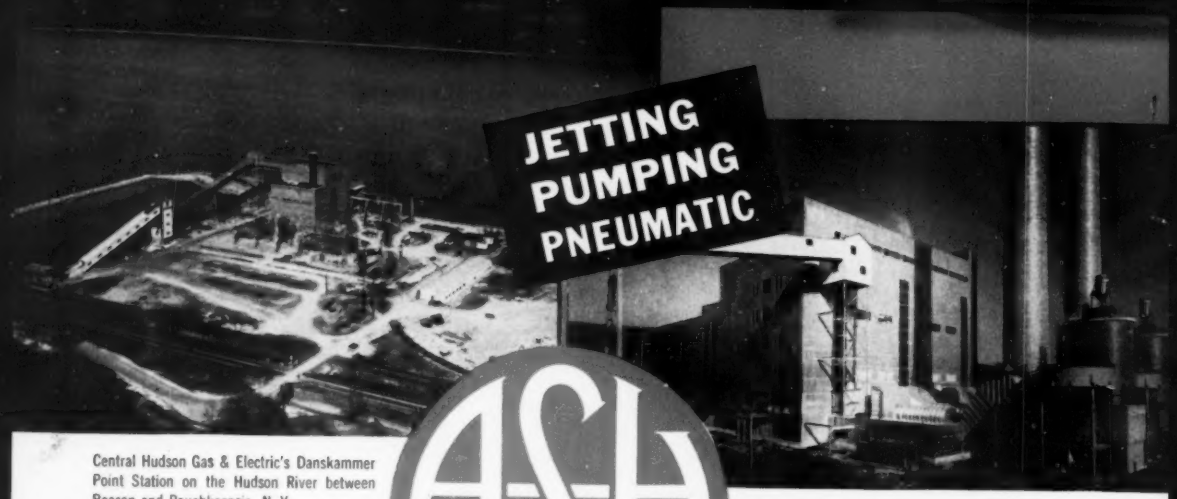
A McGRAW-HILL PUBLICATION



IN THIS ISSUE:

A 32-p handbook on

BEARINGS AND LUBRICATION



Central Hudson Gas & Electric's Danskammer Point Station on the Hudson River between Beacon and Poughkeepsie, N. Y.

A-S-H

Metropolitan Edison's new Titus Station near Reading, Pa.

In the better Plants of Today . . . and the better Plans for Tomorrow

Potomac Edison's giant generating station at Alexandria, Va.

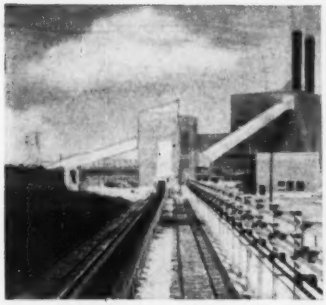
Handling the tremendous tonnages of ash and dust in these big plants calls for top engineering and equipment. But smaller installations can benefit from this kind of efficiency, too. Regardless of plant size, there's an A-S-H system that can dispose of your refuse hydraulically or pneumatically, and do the job at lower cost per ton. Write for our latest bulletins.

THE ALLEN-SHERMAN-HOFF CO.
Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.
Offices and Representatives in Principal Cities

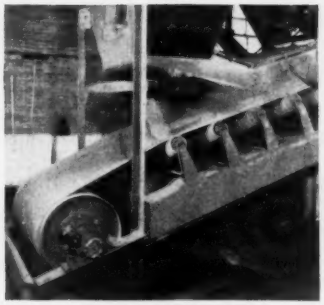
HYDROJET (hydraulic) HYDROVAC (pneumatic)

materials handling systems

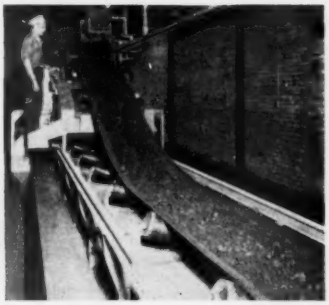
LINK-BELT engineering experience...



Belt conveyors deliver coal to storage yard and power plant.

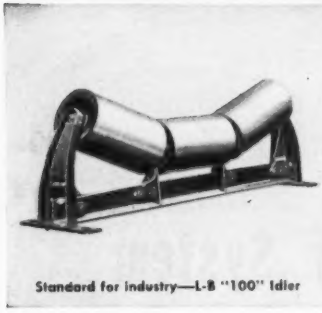


Chutes deliver graded coal to an ascending belt conveyor.

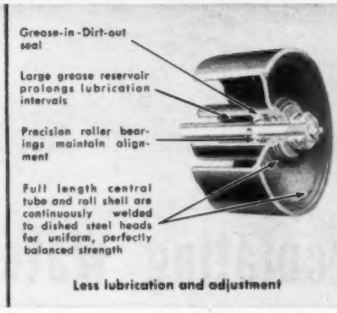


Distributing belt conveyor discharges coal to overhead bunker.

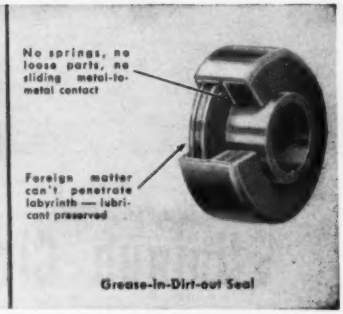
plus LINK-BELT quality components...



Standard for industry—L-B "100" Idler


Grease-in-Dirt-out seal
Large grease reservoir prolongs lubrication intervals
Precision roller bearings maintain alignment
Full length central tube and roll shell are continuously welded to dished steel heads for uniform, perfectly balanced strength

Less lubrication and adjustment


No springs, no loose parts, no sliding metal-to-metal contact
Foreign matter can't penetrate labyrinth — lubricant preserved

Grease-in-Dirt-out Seal

add up to your best bet in BELT CONVEYORS

In power plants all over the world, LINK-BELT Belt Conveyors provide reliable, efficient coal handling

Get the finest in modern coal handling in your power plant. It can be as simple as calling in a Link-Belt engineer while you're still in the planning stage.

Thousands agree Link-Belt builds the finest belt conveyors on the market today. More, it has the most complete line of components—all types and sizes—idlers, take-ups, pulleys, trippers, bearings and power transmission drives. Plus all related equipment—other types of conveyors, feeders, elevators, car dumpers and shakers, weigh larries.

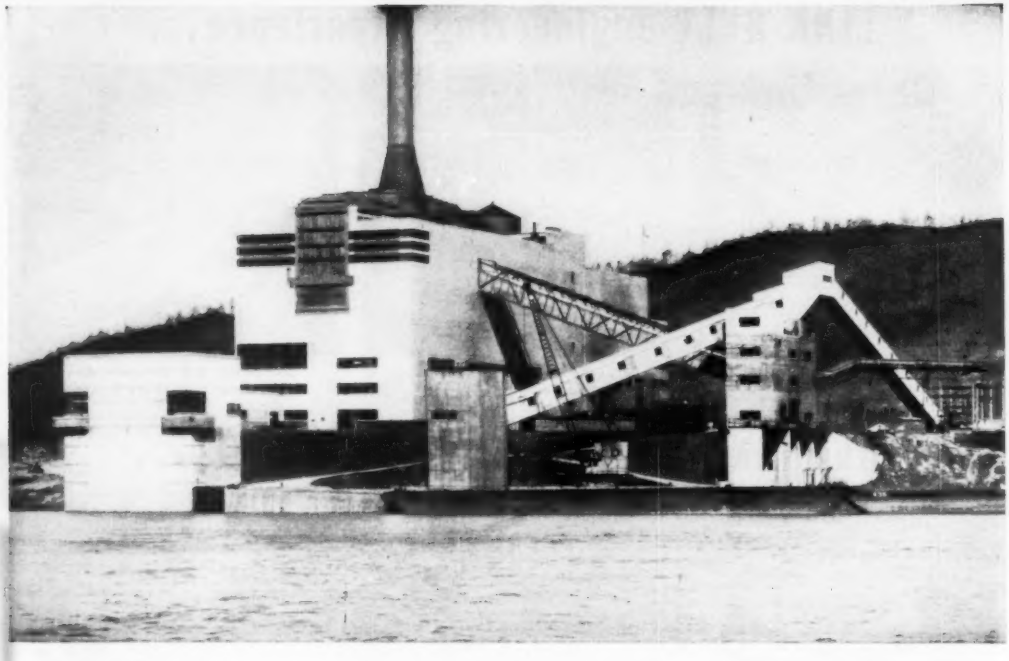
Equally important, Link-Belt Belt Conveyor engineers can draw on the broadest coal handling experience in the industry. They'll work with you and your consultants—help you come up with the right system for your requirements.

Call or write the Link-Belt branch office nearest you for the services of a belt conveyor expert.

LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in Principal Cities. 12,248



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

Z.1.1

WORTHINGTON

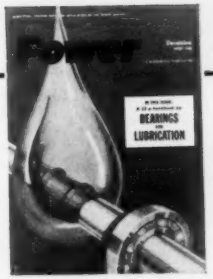
WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters	Boiler Feed Pumps	Steam Turbines
Steam-Jet Ejectors	Water Treating Equipment	Surface Condensers

Power

DECEMBER 1951 VOLUME 95 NO. 12

combined with Operating ENGINEER



ENGINEERING AND MANAGEMENT

Foreword: Let's dig out that scrap 67

Gas-turbine plants line up for review 71

Emergency diesel shutdown systems: how they work 74

3-billion-gpd pumping plant 78

HANDBOOK ON BEARINGS AND LUBRICATION 32-page special section for practical engineers 79

Friction: how to lick it	80	Fluid & solid lubes, greases	95
Guide to slide bearings	84	Keeping used oil usable	100
Guide to roller bearings	88	Applying the lubricant	104
Testing the lubricant	92	Planned lubrication pays	107

Defense Digest: Roundup of mobilization news for power men 111

PLANT OPERATION AND MAINTENANCE

Four life-saving tips for plant maintenance 115

Don't miss your biggest maintenance show 117

Raising a steel stack? 118

Your liners can crack unless you stop them 120

Where to spot belt openings 122

Install cold system right—check 10 points 124

Boeing goes after soaring Btu's 126

Turbine pump in demand for its unique features 128

How to catch turn-to-turn shorts by fast, easy test 130

Arguments	133	How to	146
Practical ideas	134	Headwork	148
Plant problems	140	Marmaduke Surfaceblow	150

READER SERVICE SECTION

Data Sheet No. 234	154	Plant equipment news	162
Power news	156	New free bulletins	171
Technical briefs	158	George Edwards	174

December 1951 **POWER** Vol. 95—No. 12

(Member ABC and ABP)

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly with an additional directory number in June, by McGraw-Hill Publishing Company, Inc., James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W 42ND ST, NEW YORK 18, N. Y.

EXECUTIVE, EDITORIAL and ADVERTISING OFFICES: 330 W 42nd St, New York 18, N. Y. Curtis W McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A Gerardi, Vice-President and Treasurer; John J Cooke, Secretary; Paul Montgomery, Senior Vice-President. Publications Division: Ralph B Smith, Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J E Blackburn, Vice-President and Director of Circulation.

SUBSCRIPTIONS: Address correspondence to POWER, Subscription Service, 330 W 42nd St, New York 18, N. Y. Allow ten days for change of address. Please indicate position and company connection on orders. Single copies 50¢. Subscription rates—U. S. and U. S. possessions: $4.00 for one year, $6.00 for two years. Canada: $6.00 for one year, $10.00 for two years. All other countries: $15.00 for one year, $25.00 for two years. Entered as second-class matter January 26, 1949 at the post office at New York, N. Y. under Act of March 3, 1879. Printed in U.S.A.

Copyright 1951 by McGraw-Hill Publishing Company, Inc. All rights reserved.

POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own index annually, copies of which are available on request to the editorial offices.

BEARINGS and lubrication being the subject of our current special section, we naturally wanted a cover symbolizing it. Charlie Marschalek, our art editor, wrestled with the problem a while and came up with an interesting preliminary design. But that was only the beginning.

Charlie then had to make his brain child come to life in the form of finished artwork. Here he had able assistance from talented members of McGraw-Hill's Illustration Dept—particularly from Jim Huget, who made the original sketch, and Adrian Nussbaum, who did the painstaking airbrushing needed to bring the drawing into full rounded form. And credit an assist to C A Decker, Dale Bearing Co, who furnished, on short notice, a ball-bearing to serve as artist's model.

Next month . . .

■ A blow-by-blow report shows how a large industrial plant's conservation program brought water costs down 5% in spite of a 36% increase in basic rate charged for water. Check it for ideas to put to work in your plant.

■ January issue brings another installment of the Insulation Handbook. Also second part of Paul Brindisi's roundup on judging water-softening methods. And another episode in Don Swift's trouble-shooting series.

■ Today's condensers are much more than "cans full of tubes." To see why, read G H Putnam's review of modern practice, explanation of what makes an efficient and economical unit.

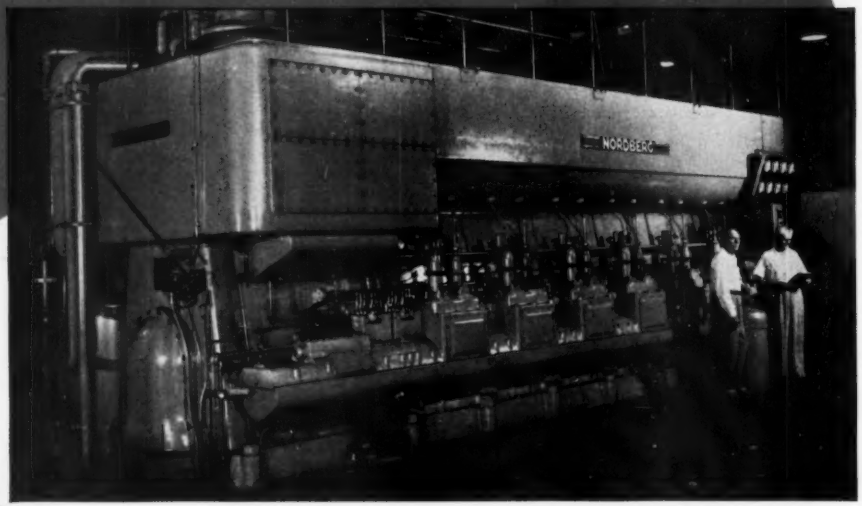
■ By January, you'll be conscious—perhaps painfully so—of heating costs. You'll find practical tips for keeping tabs on them in a brass-tacks article on degree-days and how to use them.

. . . and future months

■ There's lots of excitement these days about small gas turbines. New designs are full of smart ideas, develop amazing outputs from tiny packages. Watch for an upcoming roundup of developments in this field.

■ Curious about this business of cathodic protection against corrosion? Shep Powell will soon give you an authoritative rundown on it.

65,000 HOURS OPERATION —WEAR NEGLIGIBLE



City of Greenville Diesel turns in impressive 5-year record lubricated with TEXACO URSA OIL

This Nordberg 2,400 h.p. Diesel engine was installed in the municipal power plant at Greenville, Texas, in 1946—and has been lubricated continuously with *Texaco Ursa Oils* in both crankcase and cylinders. G. C. Pullen, Master Mechanic, reports on its condition at the latest inspection—

"We took the engine down at about 65,000 hours' operation. When we miked the cylinders, the greatest amount of wear found was only .018"—and that at only two points. Most of the measurements ranged from .008" to .015"—an average of only .0002" wear per 1,000 hours of operation. Furthermore, in No. 1 cylinder the original rings, delivered on the engine in 1946, were found to be in such good condition they were placed right back in service."

☆ ☆ ☆

Count on *Texaco Ursa Oil* to give *your* Diesels the clean operation that means less wear, less maintenance cost, less fuel consumption. *Texaco Ursa Oil* is highly resistant to oxidation . . . keeps rings free, valve action smooth and snappy. Assures longer life for bearings and all moving parts. In two-cycle engines, ports stay clear.

There is a complete line of Texaco Diesel lubricating oils approved by leading Diesel engine builders and preferred by operators everywhere. In fact—

For over 15 years, more stationary Diesel h.p. in the U. S. has been lubricated with Texaco than with any other brand.

Call in a Texaco Lubrication Engineer for full details. Just contact the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. METROPOLITAN OPERA broadcasts every Saturday afternoon.

Power

P W SWAIN *Editor*

L N ROWLEY	*Executive Editor*
F A ANNETT	*Contributing Editor*
S M ELONKA	*Associate Editor*
J C McCABE	*Associate Editor*
J J O'CONNOR	*Associate Editor*
B G A SKROTZKI	*Associate Editor*
T G HICKS	*Assistant Editor*
C F SANDERS	*Assistant Editor*
C F MARSCHALEK	*Art Editor*

Washington: GEORGE B BRYANT JR
WORLD NEWS OFFICES: London, Paris, Frankfort, Tokyo Melbourne, Rio de Janeiro, Mexico City

SHELTON FISHER *Publisher*
CLARK BOUGHTON *Sales Manager*

DISTRICT MANAGERS
W W QUARLES, 330 W 42nd St, New York 18, N. Y.
C R LONG, Architects Bldg, Philadelphia 3, Pa.
J E SLATER, 1427 Statler Bldg, Boston 16, Mass.
W K PONDER, 1510 Hanna Bldg, Cleveland 15, Ohio
L W ROMIGH, J L KING, 520 N Michigan, Chicago 11
J H CASH, First National Bank Bldg, Dallas 1, Tex.
JOHN OTTERSON, 68 Post St, San Francisco 4, Calif.
J H ALLEN, 1111 Wilshire Blvd, Los Angeles 17, Calif.

...with Power readers...

ALFRED VAKSDAL PASSES ON

Dear Phil Swain: Excuse it please, but I feel as if I know you well.

My father, Alfred Vaksdal, passed away on October 9 at Danville, Ky. Services were held at Corning, N. Y. October 11.

He always and often spoke of you in such complimentary terms. I am sure he numbered you among his very best friends. He urged me to visit you when the occasion presented itself. Unfortunately you were in the Pacific on Atom Bomb Tests on my last visit to New York.

I am presently Plant Engineer with the American Enka Corp, Morristown, Tenn. At present I intend to visit the ASME meeting at Atlantic City. I then may have the privilege of meeting you.

LOWLAND, TENN. *Steinar Vaksdal*

To me the death of Alfred Vaksdal is a great personal loss. He was a wonderful engineer and a "big man" in every sense of the word—tall, heavy set, full of honest and homely wisdom.

When others got panicky, Al stood like the Rock of Gibraltar. I well remember, years ago, when a rising flood at the Corning plant had already reached the boiler ashpits and was threatening the giant glass casting for Mt. Palomar's 200-in. telescope mirror, then slowly cooling under thermostatic control. "What shall we do?" every-

(*Continued on page* 212)

...lines and bylines

D B Wagner

DIRECT SERVICE to its readers is only part—albeit a major part—of an industrial magazine's operations. Leading publications must always be alive to the needs of the industries they serve. It's to meet such a need that we publish POWER's *Directory of Manufacturers' Agents*, a new edition of which came off the press this summer ($10.00 per copy, additional copies at $2.50 each).

The directory lists 1446 domestic manufacturers' agents, with the areas they cover, the lines they handle, the size of their sales staffs. It represents about a year of patient survey and research by Dorothy Bird Wagner, able and attractive assistant to POWER's publisher, Shelton Fisher.

By aiding manufacturers to secure topnotch representation in all parts of the country, the directory really turns out to be a service to you, the reader. Your job of power-equipment buying goes a lot easier if you have well-informed sales engineers handy to help you.

S C Page

IF HE'D TRIED, good friend Schuyler Page couldn't have lived a life better suited to making him a topnotch writer of practical stuff for power men. From his first job as apprentice machinist in his native Minnesota, he's spent about all his time installing, operating, testing, overhauling and revamping power machinery, both mechanical and electrical. From early experiences he likes to recall erecting the then-new producer-gas engines and a pioneer plant for liquefied hydrocarbon gas.

In recent years, Schuyler has concentrated on operation, been in charge of plants for American Laundry Machinery, Chevrolet Motor & Axle, Wm Simon Brewery. It was in the latter assignment that he had the set-to with the stack, about which he tells in brass-tacks fashion on p 118. Right now, Schuyler is enjoying retirement, with time out for an occasional writing chore.

J J O'Connor

SLIGHTLY GROGGY, but with his Irish smile undimmed, Jim O'Connor not long ago put the finishing touches to the Handbook on Bearings and Lubrication, pp 79-110. In so doing he wound up a concentrated day-and-night stint of many months' duration.

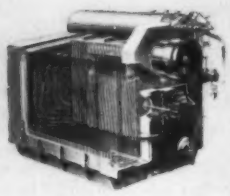
Yet it's truer to say that the job began back in early 1948 when Jim first reported for work. Then he learned each POWER editor is expected to become a specialist in one or more technical fields. Jim was asked to concentrate on electrical engineering, mechanical transmission and lubrication—to be ready someday to inherit part of Fred Annett's mantle. Like all POWER editors, Jim hit the trail on his specialties—handled all articles dealing with them, answered all questions stemming from them, attended all technical meetings concerned with them, got to know the top practitioners in them.

So, although Jim took a sort of PG course in lubrication at MIT last summer, and did a lot of special digging for handbook info, he didn't start from scratch, thanks to POWER's specialist system.

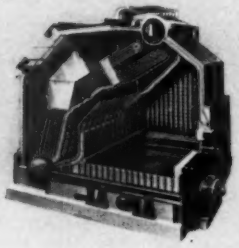
now

...B&W INTEGRAL-FURNACE

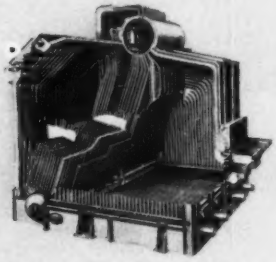
for steam requirements from 2800 to 350,000 lb. per hr.



TYPE FM
(Factory-assembled Unit)



TYPE FF



TYPE FJ

cost-saving features

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings even with high boiler water concentrations
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

over 167 million lb. of steam per hr. for these industrial, utility, and other users

Abrasives
Airlines
Automotive
Baking
Beverages
Brewing
Building Materials
Candy
Chemicals
Dairy
Distilling
Drugs
Electrical
Electronics
Food
Foundry
Fruit Packing
Glass
Iron & Steel
Laundry
Leather
Lumber
Machinery
Meat Packing
Metal Working
Mining
Non-Ferrous Metals
Oil Refining
Paint
Paper
Plastics
Process
Rubber
Sugar
Textile
Tobacco

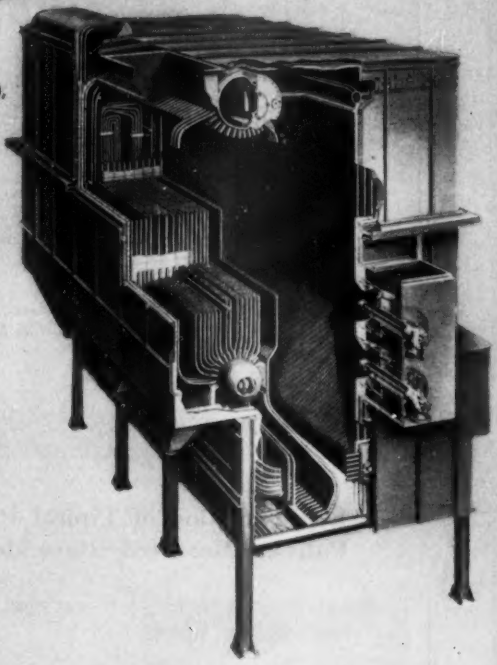
Utilities
Gas Companies
Municipal Plants
Power Plants
Railroads

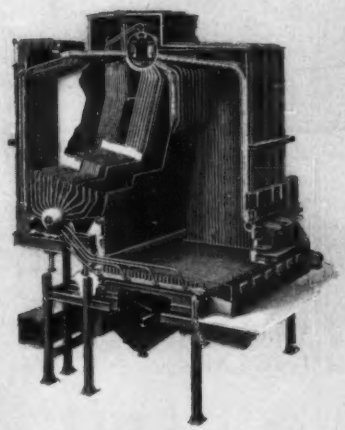
Others
Colleges
Florists
Hospitals
Hotels
Housing Projects
Institutions
Military Posts
Navy Yards
Office Buildings
Ordnance Plants
Stores

BOILER ADVANTAGES

Examples of B&W Engineering For Economy

TYPE FH
with hopper bottom (as shown), or flat floor





TYPE FL

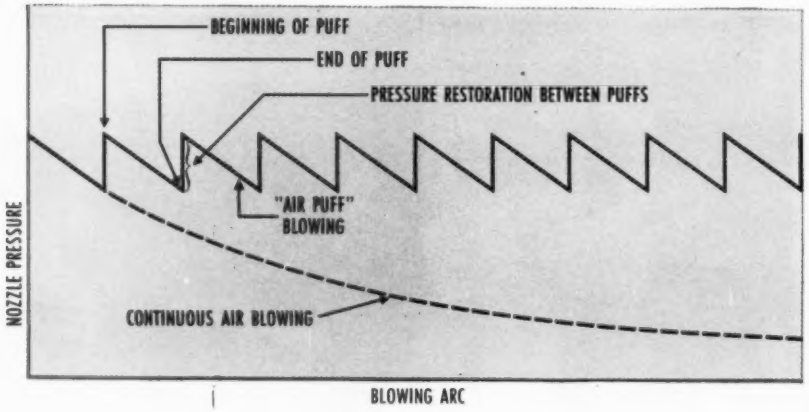
the B&W integral-furnace BOILER family

TYPE	CAPACITY RANGE LB. STEAM/HR.	PRESSURE PSI	TEMPERATURE	FIRING
FM	2,800- 25,000	15- 275	Saturated	Oil and Gas
FF	8,000- 50,000	160- 600	Superheat	Stoker, Oil, and Gas
FJ	30,000- 70,000	160- 800	Superheat	Stoker, Oil, and Gas
FL	60,000-120,000	160-1050	Superheat	Stoker, Oil, and Gas
FH	50,000-350,000	160-1050	To 910 F	Pulverized, Coal, Oil, and Gas

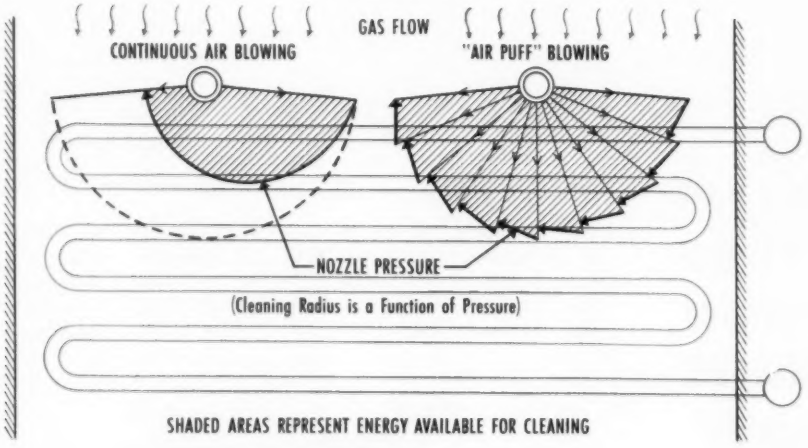
BABCOCK & WILCOX

G-5227

Controlled, HIGH SUSTAINED Air Pressure Throughout Each Puff
(Independent of Receiver Capacity and Compressor Size)



Representation of Typical Puffing Application
Puffs are Measured—Have Identical Travel Ares


GAS FLOW
CONTINUOUS AIR BLOWING
"AIR PUFF" BLOWING
NOZZLE PRESSURE
(Cleaning Radius is a Function of Pressure)
SHADED AREAS REPRESENT ENERGY AVAILABLE FOR CLEANING

Why the Diamond Automatic "AIR PUFF" Principle of Soot Blowing means Cleaner Boilers at Lower Costs

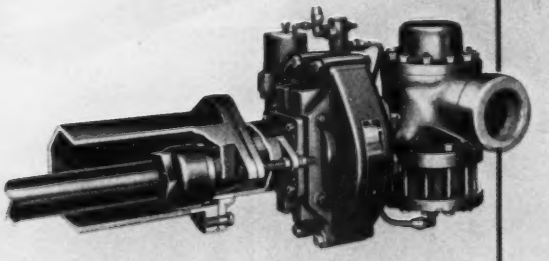
The Diamond Automatic "AIR PUFF" Soot Blower is a precision machine with all functions carefully controlled and interlocked to provide better boiler cleaning at lower cost.

Definite cleaning advantage is obtained; first, as a result of using air at high density as a cleaning medium, and second, by employing the well-known puff or "shock" method of creating a large number of powerful impulses.

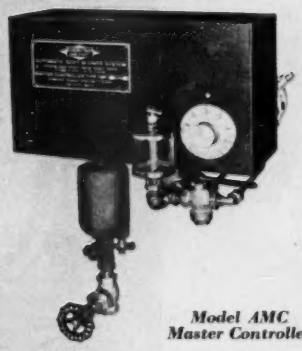
As illustrated schematically on the left hand page, the controls function in such a manner that air issues from the multiple nozzles in *sustained* high pressure puffs that are independent of receiver capacity and compressor size. During each puff, the element rotates through a predetermined and measured short arc. Then the valve shuts off and the element stops rotating during the timed interval while the compressor restores the original air pressure . . . after which the valve reopens and the element starts rotating again for the next puff. The action is entirely automatic, and when the cycle is completed the blower shuts off. Each blower head is automatically started and operated in turn until the cleaning operation is completed.

This combination of *sustained* high pressure puffs with precise rotation of the element through a measured arc each time assures thorough cleaning at less cost. No air is wasted at low pressure when it cannot clean effectively. Controlled element rotation uniformly covers all the surface to be cleaned.

The Diamond "Air Puff" principle permits use of much smaller, less costly compressor and receiver equipment. Air puff blowers can be operated while the boiler is on automatic operation. Dust loading control is another important advantage. Control being entirely automatic, the expense and uncertainty of the human element are eliminated. For further information, write for Catalog No. 1014 U.



Model A2E Automatic "Air Puff" Soot Blower Head

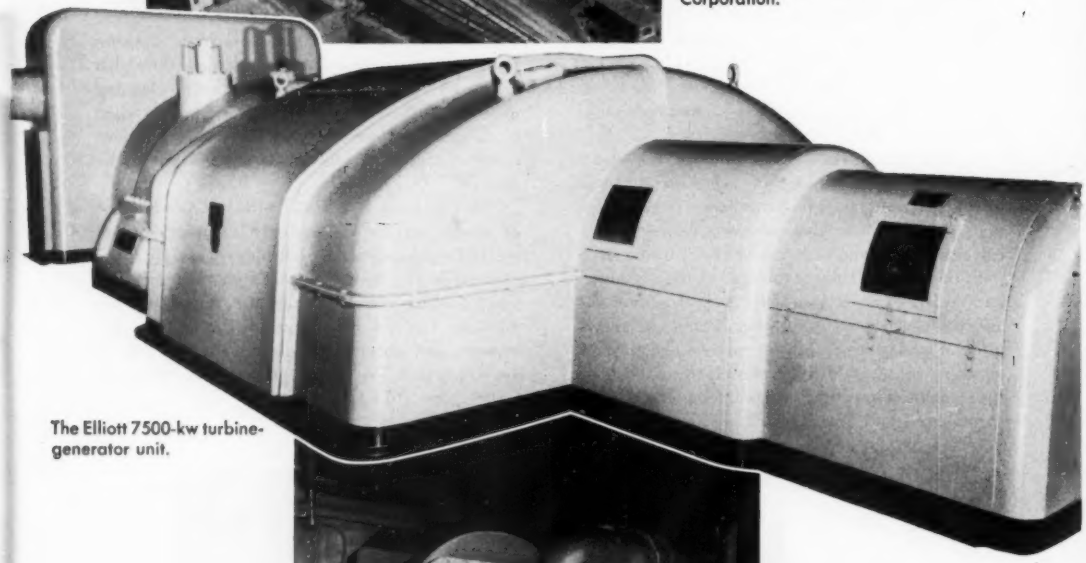


Model AMC Master Controller

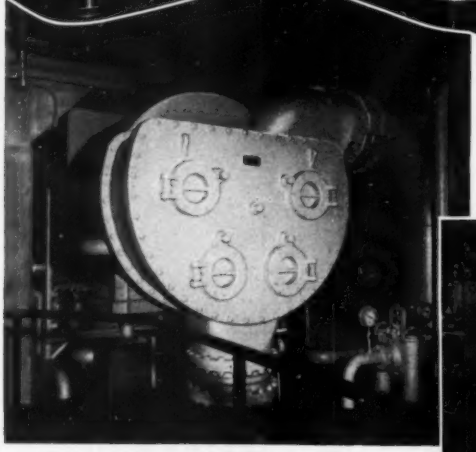
DIAMOND POWER SPECIALTY CORPORATION
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

4431

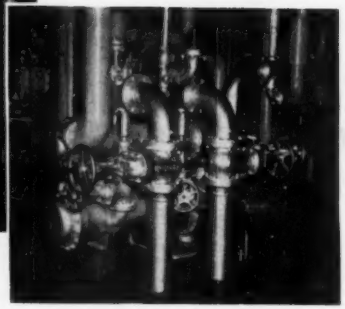
The new Caribou, Maine, station of the Maine Public Service Company. Design, purchasing, expediting, and construction by Stone & Webster Engineering Corporation.



The Elliott 7500-kw turbine-generator unit.



Serving the main turbine, the Elliott two-pass surface condenser.



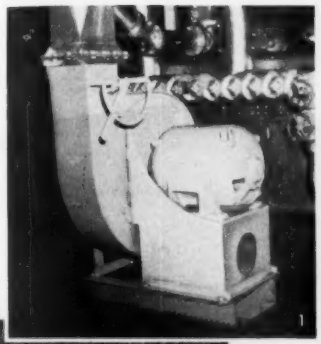
Close-up of the Elliott twin two-stage steam jet air ejector.

MAINE goes ELLIOTT!

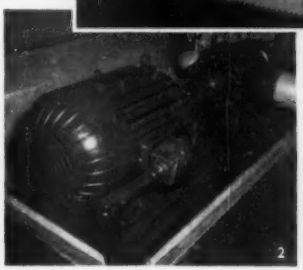
. . . in the new Caribou Steam Plant, Aroostook County

The full Elliott slate takes office in this recently completed Maine Public Service Company station, located at Caribou, and serving 3600 square miles of northeastern Maine, and parts of adjoining New Brunswick. Turbine-generator, condenser, air ejector, deaerating heater, and a raft of motors driving auxiliaries, all are of Elliott design and manufacture. The Caribou diesel plant, formerly the mainstay of power needs in the territory, has Elliott generators on the two larger of its four units, two Elliott turbochargers, and Elliott twin oil stainers and tube cleaning equipment.

It is our firm belief that conservative down-East estimation of true values for which the State of Maine is noted was used in the selection of equipment for this new station.



1



2

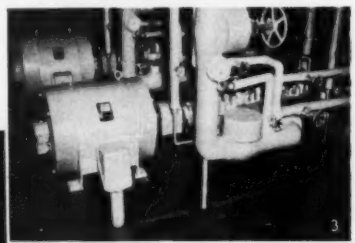
ELLIOTT Company

JEANNETTE, PA.

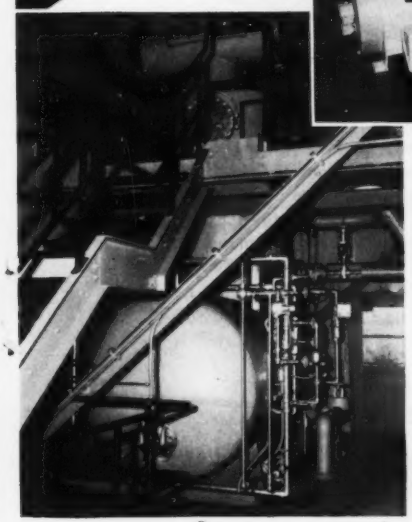
Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

Q-1157



3



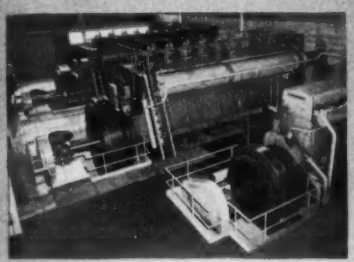
Four of the many Elliott Crocker-Wheeler motors in auxiliary service:

(1) A 20-hp 3600-rpm a-c motor driving the overfire fan.

(2) An Elliott Crocker-Wheeler Sealedpower motor, 15 hp, 585 rpm, driving the transfer oil pump.

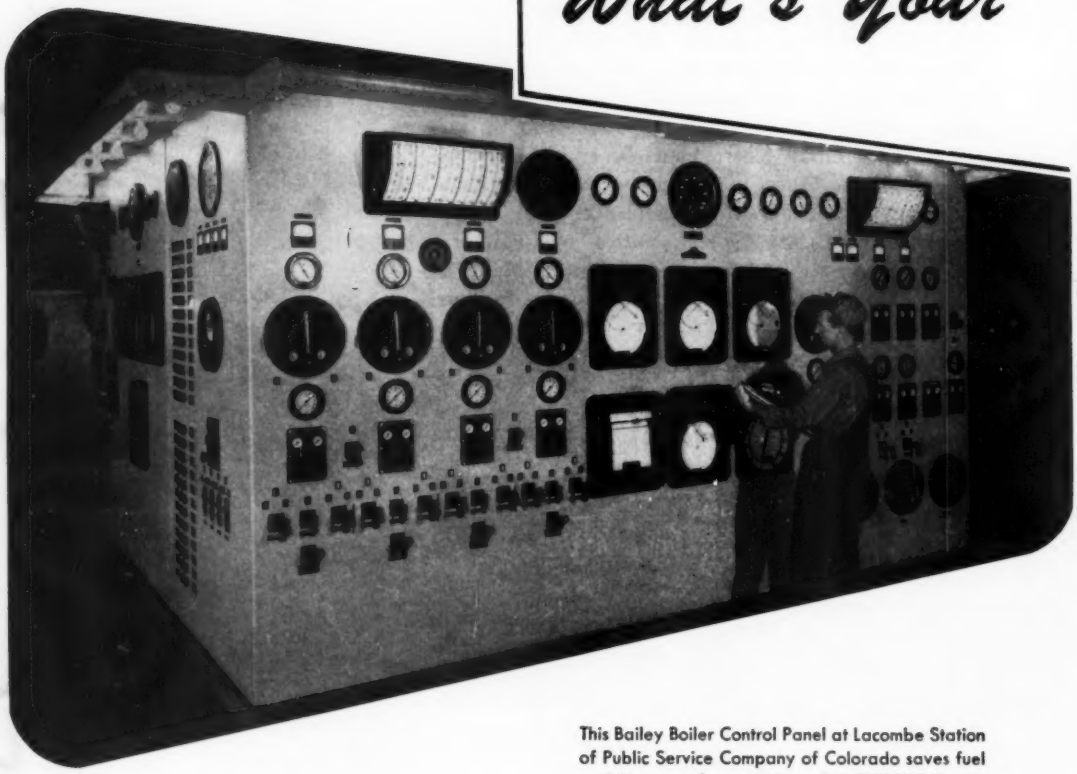
(3) Two 200-hp 3550-rpm squirrel-cage induction motors on boiler-feed pumps.

At left: The Elliott 100,000-lb-per-hr deaerating feedwater heater.



● THE CARIBOU DIESEL PLANT was hurriedly built when hydro power became inadequate. The two larger of its four units have Elliott generators, the two smaller units have Elliott turbochargers.

What's Your



This Bailey Boiler Control Panel at Lacombe Station of Public Service Company of Colorado saves fuel and insures safe operation of a 350,000 lb per hr 850 psi, 900 F boiler fired by pulverized Colorado Lignite Coal and/or natural gas.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Control-Dollar Efficiency ?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. Complete Range of Equipment—fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you. Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

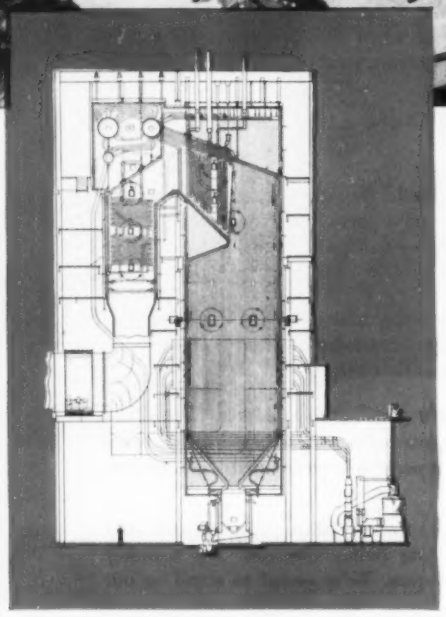
For better control-dollar efficiency—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-2

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

VULCAN for of METROPOLITAN Repeat



The first two units are now in service at Titus Station of Metropolitan Edison Company, near Reading, Pennsylvania.

Each of the two reheat boilers was built by Combustion Engineering-Superheater, Inc., with a capacity of 510,000 pounds of steam per hour at 1450 psi and with reheat to 1010 degrees F. Firing is with pulverized coal.

Boiler cleaning is by Vulcan, with fully automatic-sequential control. Each boiler has ten long retractable soot blowers driven by electric motor, eight air-driven wall blowers, and controls for the two electric-driven air heater blowers. Air is the blowing medium.

The consulting engineers for Metropolitan Edison Company were Gilbert Associates, Inc.

VULCAN Automatic

AUTOMATIC—SEQUENTIAL SYSTEM

TITUS STATION
EDISON COMPANY

Metropolitan Edison Company a Vulcan user at Crawford and Eyler Stations, has now swung to *fully automatic-sequential* Vulcan soot blowing for Titus Station.

Standing at the control panels, adjacent to all other boiler instruments, the operator [illegible] does the complete soot blowing job by merely pushing a single button.

Operation of the Vulcan system is right before his eyes. He can see at a glance that each unit automatically cuts into operation at the right time and pressure, blows for the proper period, and cuts out of service. If any unit requires more—or less—frequent blowing, the control is at his fingertips.

There is no need to waste time or effort climbing to remote locations —no excuse for forgetting to blow on schedule.

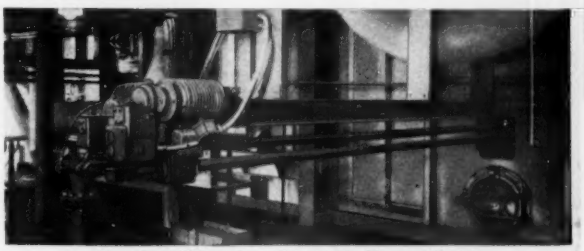
A Vulcan Automatic-Sequential System is designed to clean boilers better at lower cost. Bulletin 483 tells the story. Write for it.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DU BOIS, PENNSYLVANIA

Duplicate Vulcan Automatic-Sequential Systems

order received for Unit 3

Two of the eight Vulcan Wall Blowers on Unit 1

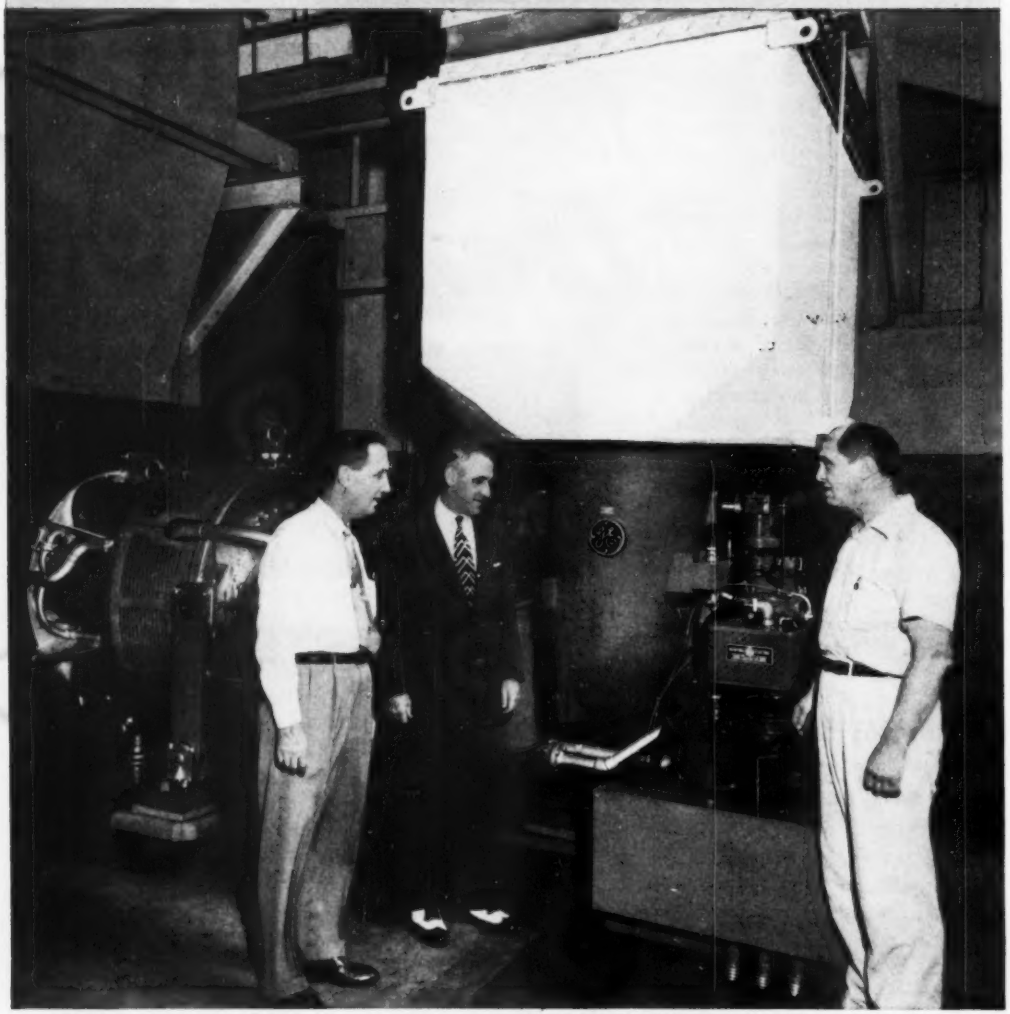


One of ten Vulcan Long Retractable Blowers, Unit 1

Combustion-Gas-Turbine

Total Installed Hours	17,604
Hours in Service	15,241
Total Power Produced in KWH	66,465,000
Average Load	4361 KW
Hours Scheduled Out	2326
Hours Forced Out	37
Unit Capacity Factor	124.6%

*A duplicate unit has just been ordered for installation in this station.



Donald S. Kennedy, President of Oklahoma Gas and Electric, inspects the 3500-kw combustion-gas-turbine at the Belle Isle Station with C. C. Willis (extreme left) Superintendent of Generation at O.G. & E. and G. D. Conley (extreme right), Chief Engineer at Belle Isle Station.

*completes 2 years at Belle Isle**

"Surpassed Expectations" says Donald S. Kennedy, President of Oklahoma Gas and Electric.

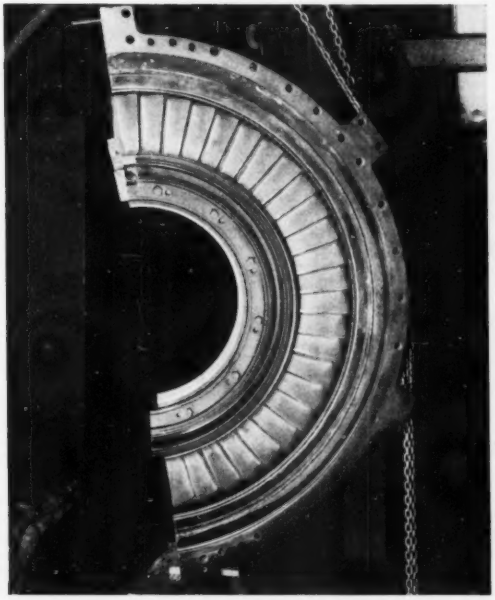
The first combustion-gas-turbine to be placed in commercial service in America has completed its second year of successful operation at the Belle Isle Station of the Oklahoma Gas and Electric Company. On the line since July 29, 1949, the 3500 kw unit has established a record which has surpassed contract commitments for both capacity and economy.

Donald S. Kennedy, President of the Oklahoma Gas and Electric Company, hailed the unit as eminently successful. "The combustion-gas-turbine at Belle Isle has been easily operated and maintained by our regular plant personnel. Maintenance costs have been lower and kilowatt output higher than we had anticipated. The output has averaged well over 100 per cent. Availability has been consistently high with only thirty-seven hours forced outage, due largely to the failure of a lube oil pump impeller. For availability, economy, and capacity, our gas-turbine has surpassed expectations."

General Electric combustion-gas-turbines are available in both 3500 kw and 5000 kw ratings. For complete details call your nearest G-E sales office or write for Bulletin GEA-5516, "Gas Turbine Power Plants." General Electric Company, Schenectady 5, New York.

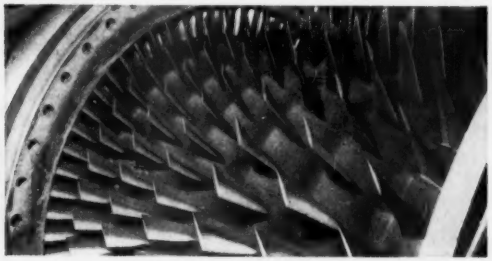
11,823-HOUR INSPECTION REVEALS EXCELLENT OPERATING CONDITION

A routine semi-annual inspection of the Belle Isle gas turbine was held in March, 1951. This careful check-up on all original parts failed to uncover any major components —either rotating or combustion—which required replacement.



This half-section of the second-stage nozzle diaphragm had undergone almost no deterioration in twenty months of service. Its condition, typical of all diaphragm pieces, warranted no maintenance.

All six combustion chamber caps were reinstalled for further service. The discoloration around the gas fuel nozzle of this cap is a deposit of noncombustible residue from the fuel.

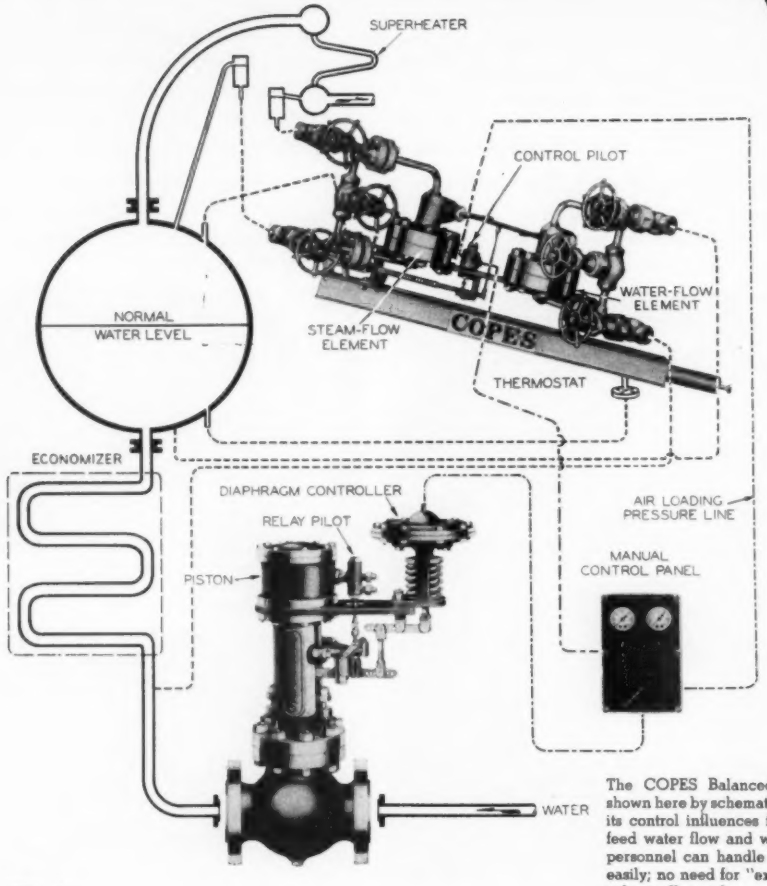


The compressor rotor, shown here with the top half of the casing removed, had collected a slight amount of dirt but was otherwise in original condition.

GENERAL ELECTRIC

255-5

PENNSYLVANIA ELECTRIC COMPANY places 6th order

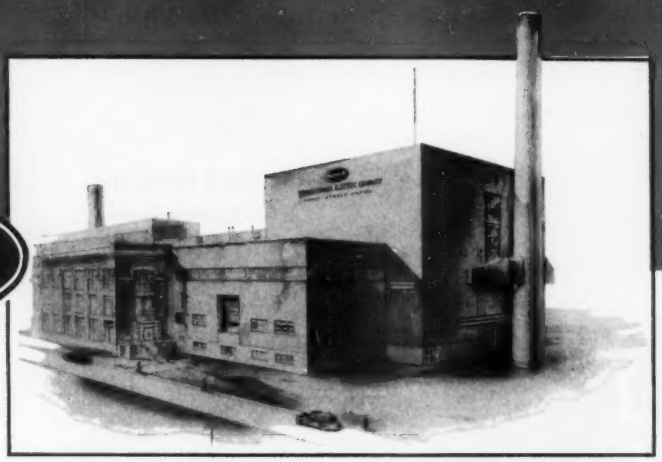


The COPES Balanced Flow Control, shown here by schematic drawing, takes its control influences from steam flow, feed water flow and water level. Plant personnel can handle all maintenance easily; no need for "experts." The feed valve will stand up under *unlimited* pressure drops.

COPES

BOILER FEED

PENELEC



Front Street Addition includes two 1250-psi, 950-F C-E boilers, each rated at 400,000 pounds of steam per hour.

for COPES MULTI-ELEMENT REGULATORS

COPES Balanced Flow Control will be used for the 1952 addition to Front Street Station of Pennsylvania Electric Company at Erie, Pa. This is the sixth time Penelec has ordered COPES Multi-Element Feed Water Control.

First installation was on the two original 675-psi boilers at Front Street, using two-element COPES Flowmatics. Two later orders placed Flowmatics on four 675-psi boilers at Seward. Two other orders equipped the four 875-psi boilers at Warren with COPES Flowmatics.

Now, for the Front Street Extension, Penelec has selected the COPES Balanced Flow—with control influenced by steam flow, feed flow and water level. This three-influence control is entirely independent of all other instruments and controls, and can remain on fully-automatic when they are out of service for routine inspection and care.

COPES Multi-Element Control is designed for the most modern boilers—for the most difficult operating conditions. Ask for proof of performance.

NORTHERN EQUIPMENT DIVISION

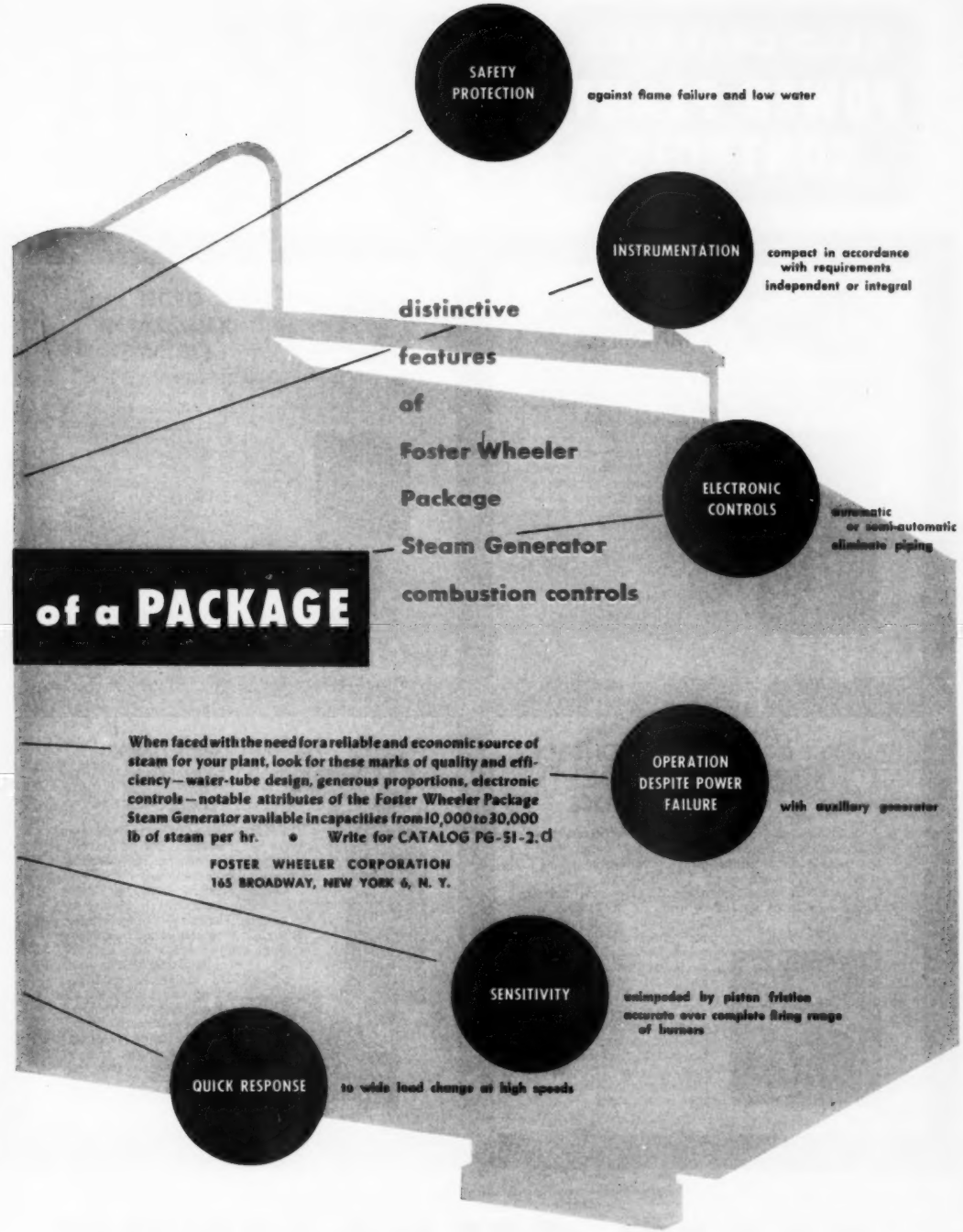
CONTINENTAL FOUNDRY & MACHINE COMPANY

1211 Grove Drive, Erie, Pennsylvania

Headquarters for **Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Alarms, Reducing Valves, Desuperheaters**

WATER REGULATION

FULLY AUTOMATIC
• push-button start
• operation at all pressures up to design pressure
all for the price
SEMI-AUTOMATIC
• manual ignition
• wide operating range
• modulating control

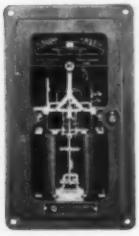

SAFETY PROTECTION
against flame failure and low water
INSTRUMENTATION
compact in accordance with requirements
independent or integral
distinctive features of Foster Wheeler Package Steam Generator combustion controls
ELECTRONIC CONTROLS
automatic or semi-automatic
eliminate piping
of a PACKAGE
When faced with the need for a reliable and economic source of steam for your plant, look for these marks of quality and efficiency—water-tube design, generous proportions, electronic controls—notable attributes of the Foster Wheeler Package Steam Generator available in capacities from 10,000 to 30,000 lb of steam per hr. • Write for CATALOG PG-51-2.d
FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.
OPERATION DESPITE POWER FAILURE
with auxiliary generator
SENSITIVITY
unimpeded by piston friction
accurate over complete firing range of burners
QUICK RESPONSE
to wide load change at high speeds
FOSTER WHEELER

ALLIS-CHALMERS POWER PLANT CONTROLS

7 Keys

1 SYNCHRONIZING MACHINES

Automatic synchronization of generators, synchronous condensers and tie lines, no matter how large, is the job done smoothly, quickly and unerringly by the *Synchro-Operator*. Just turn a control switch and it takes over — indicates relative speed and phase angle . . . anticipates time for circuit breakers to close.



The *Synchro-Operator* is absolutely safe and eliminates the danger of manual synchronizing errors. It automatically brings the incoming machine into step with the line and closes the generator breaker at exact synchronism. With the *Synchro-Operator*, it's possible to synchronize from a remote point.

2 ORDER TELEGRAPH SYSTEMS

The Allis-Chalmers Order Telegraph System is accurate and reliable. Sending and receiving orders is accomplished on one dial — saves valuable switchboard space — aids operating personnel. Receipt of each message is assured by an alarm system which operates until the order is returned correctly.

The many uses of Allis-Chalmers dc Positioning Devices include control and indication of remote valves in hydro plants, transmission of orders between switchboard and turbine room, gate position indication and control, water level indication, and hydraulic turbine governor control. Select either a five or ten-inch semiflush dial.

5 *ROCKING CONTACT* VOLTAGE REGULATORS

Rocking Contact Voltage Regulators have established long records of dependability. "Not one dollar spent for maintenance in fifteen years of continuous service," is typical experience.

Designed for panel mounting, this regulator makes a neat installation on any switchboard. Regulation is achieved by rocking a carbon-rimmed sector over a silver-plated stationary commutator to control the amount of resistance in the exciter shunt field.

When selecting generator voltage regulators, remember that Allis-Chalmers builds both mechanical and rotating types . . . ; makes recommendations based on your requirements.

6 STARTING AUXILIARY MOTORS

There is an Allis-Chalmers starter for every motor need . . . full or reduced voltage; for synchronous, wound-rotor or squirrel-cage motors.

Choose Type H Starters for 2300-5000 volt motors. They are engineered to your application — offer complete protection to personnel and equipment through compartmented cubicles, current limiting fuses, overload, undervoltage, interlocking and other devices.

For 110-550 volt motors, sizes 0 to 7 starters cover the range from fractional to 600 hp. Select from a variety of enclosures and operating arrangements to fit your needs.

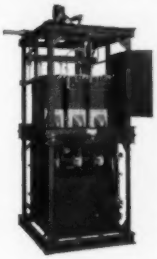
Synchro-Operator, Regulex and Rocking Contact are Allis-Chalmers trademarks.

ALLIS-CHALMERS

to Dependable Power

3 BOILER DRAFT FAN SPEED CONTROL

Draft fans operate at exactly the speed your boilers require for perfect combustion when Allis-Chalmers Type 257 Liquid Rheostats are used with wound-rotor drive motors. The right draft for any combustion condition is provided automatically by the wide range stepless speed control.

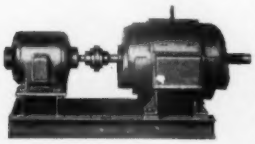


They have few moving parts, no arcing contacts, no mechanical connections to either fan or motor. Not only is the Allis-Chalmers Liquid Rheostat compact in size, but it can be placed in any convenient location—doesn't have to be adjacent to the motor it controls.

4 *REGULEX* VOLTAGE REGULATORS

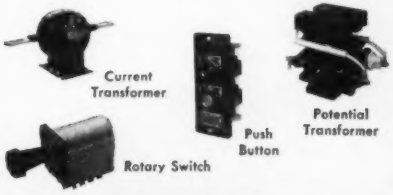
The *Regulex* Voltage Regulator is the most modern method of controlling voltage on large generators. *Regulex* Control eliminates the pilot exciter . . . has no vibrating or moving contacts.

High amplification and fast response of the *Regulex* Generator Voltage Regulator on system disturbances causes the generator field current to reach the required value for stability at the new load rapidly—thereby decreasing the possibility of the generator pulling out of synchronism . . . improving system stability and giving better regulation under all system conditions.



7 CONTROL BOARD AND SWITCHGEAR DEVICES

Allis-Chalmers switchgear devices include rotary control switches, pushbutton stations, current and potential transformers, disconnecting switches, indicating lamps, terminal boards, thermal relays, oil and air contactors, oil and air circuit breakers. All are designed and built to the high standards of reliability associated with the name Allis-Chalmers in power plant equipment.



SEND FOR MORE INFORMATION

These seven key power plant control devices are described more fully in bulletins and leaflets. Check off those you'd like to have on the coupon below and give it to your A-C representative, or send it to Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS Milwaukee 1, Wisconsin

Send me the leaflets and bulletins checked below:

- ☐ *Synchro-Operator* 14S63868
- ☐ dc Positioner 14B6641
- ☐ Liquid Rheostat 14S7544
- ☐ *Regulex* Voltage Regulator
  Rocking Contact Regulator
  - ☐ for small machines 14B6035
  - ☐ for larger units 14B6015
  - ☐ for dc generators 14B6137
- Starters
  - ☐ Type H 14B6410
  - ☐ Sizes 0 to 7 ..... 14B7132
- ☐ Switchgear and Control Devices 25B7095
- ☐ Type 256 Air Contactor 14B7303

Name ..... Title .....

Company .....

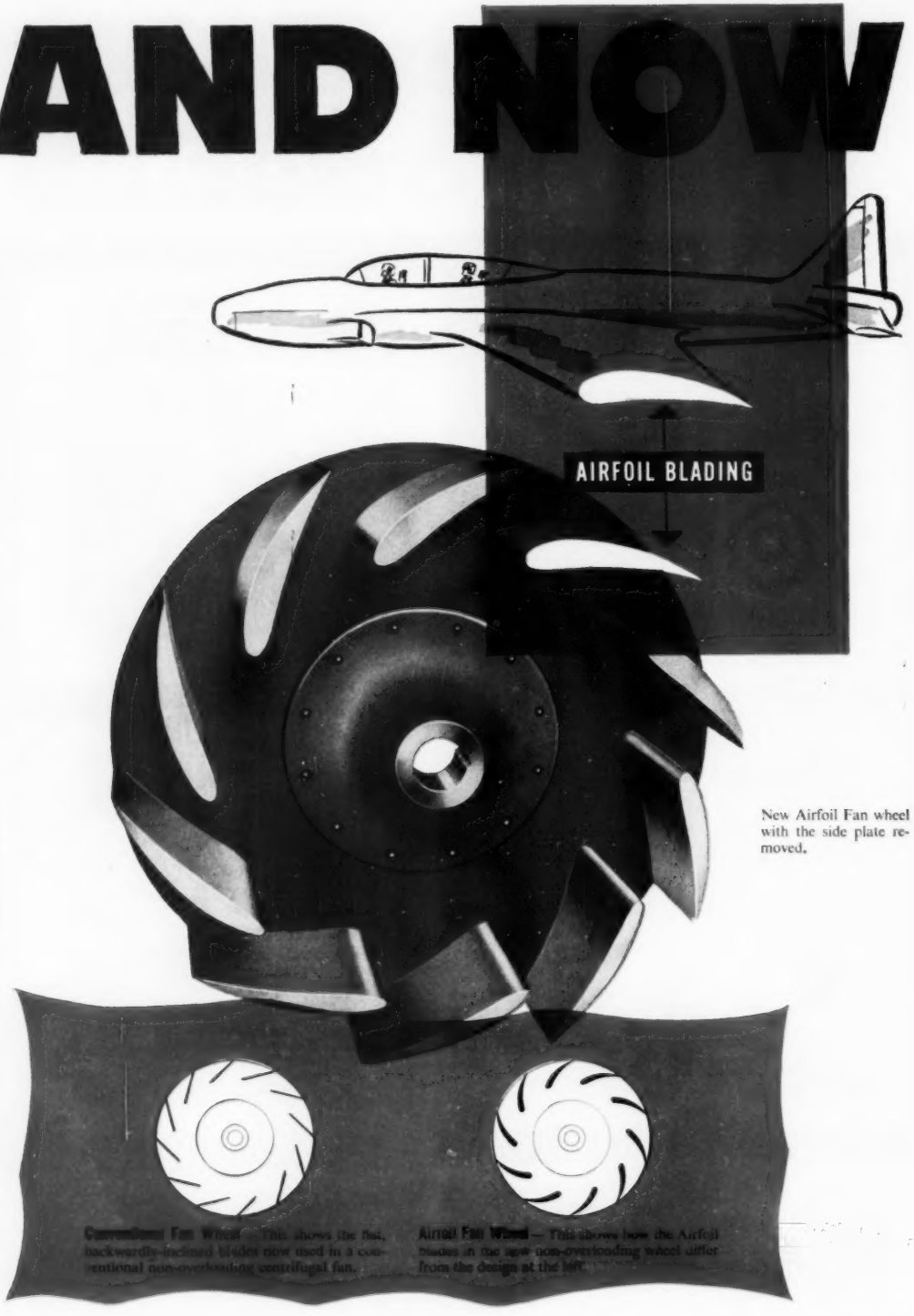
Address .....

City ..... State A-3500

A-C ALLIS-CHALMERS

Pioneers in Power and Electrical Equipment from Generation through Utilization

AND NOW



New Airfoil Fan wheel with the side plate removed.

Conventional Fan Wheel — This shows the flat, backwardly-inclined blades now used in a conventional non-overloading centrifugal fan.

Airfoil Fan Wheel — This shows how the Airfoil blades in the new non-overloading wheel differ from the design at the left.

A CENTRIFUGAL FAN WITH AIRFOIL BLADING

Sturtevant Pioneers Again

Here's another major advance in fan design by Sturtevant —the new Airfoil Non-Overloading Centrifugal Fan.

In 1914, Sturtevant made high efficiency possible with the non-overloading centrifugal fan—the TURBOVANE®. Then, in 1930, low-cost Sturtevant VANE CONTROL® increased the efficiency of part-load operation. Now, in 1951, the new Sturtevant Airfoil blade achieves new heights in peak efficiency with "the wings of an airplane" housed in a centrifugal fan.

Higher Efficiency and Quieter Operation

Sturtevant's scientific application of Airfoil Blading produces a new high in efficiency and a new low in noise level:

Efficiency . . .	**90% plus**
Noise Level . .	**65% less**

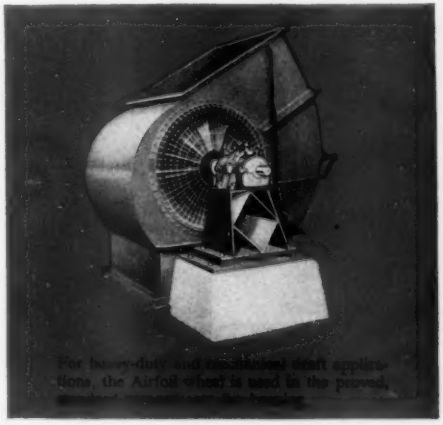
Wherever operating cost means more than first cost—where evaluation and a reasonable price mean more than a low price—the Sturtevant Airfoil, Non-Overloading Fan is the answer.

Recent Purchasers

Airfoil Fans were selected by the Consolidated Edison Company of New York for their Astoria and East River Plants, and have been *successfully witness tested.* Other orders have been received from Duke Power Co., New York Gas & Electric Co., Pennsylvania Electric Co., Tennessee Valley Authority, and also for ventilation of the new Squirrel Hill Tunnel in Pittsburgh.

Where To Use

If low operating cost is of primary importance to you in your air handling applications, as it is in mechanical draft for utility and industrial power plants, in high-velocity air conditioning systems, and for vehicular tunnel ventilation, this new fan is available to you. For full information, contact your local Westinghouse-Sturtevant office, or write to Westinghouse Electric Corporation, Sturtevant Division, 165 Damon St., Hyde Park, Boston 36, Massachusetts.



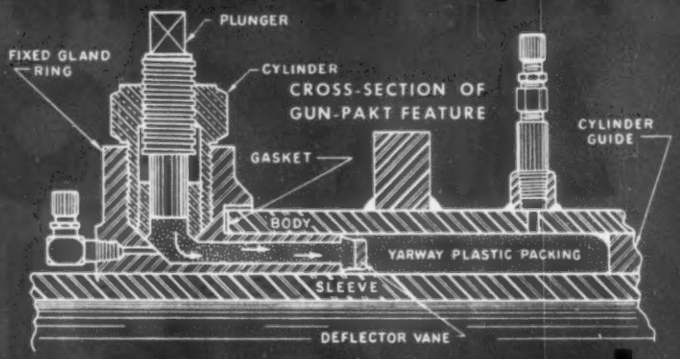
YOU CAN BE SURE...IF IT'S Westinghouse

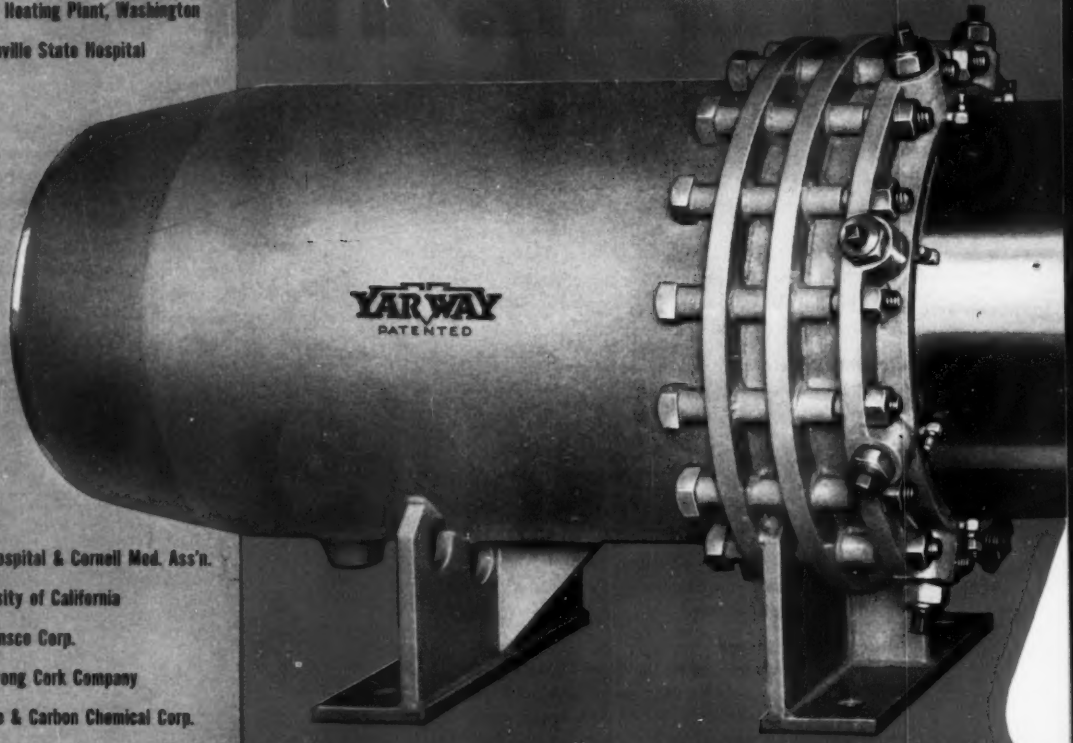
J-80244

TYPICAL USERS

Allegheny Co. Steam Heating Company
Sanitary District of Chicago
City of Cleveland
Florida Power & Light Company
Georgia Power Company
Philadelphia Electric Company
Dayton Power & Light Company
Camarillo (Cal.) State Hospital
Central Heating Plant, Washington
Jacksonville State Hospital

this expansion joint



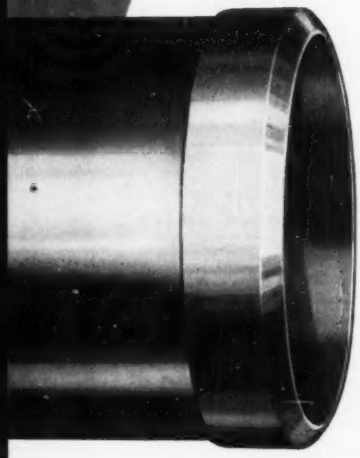


N.Y. Hospital & Cornell Med. Ass'n.
University of California
Agfa Ansco Corp.
Armstrong Cork Company
Carbide & Carbon Chemical Corp.
Chrysler Corp.
General Motors Corp. (Buick Div.)
General Motors Corp. (Chevrolet Div.)
Westinghouse Electric Co.
West Central Heating Plant, Wash., D.C.
University of Washington
Public Service Company of Colorado

YARWAY

offers...

FREEDOM FROM SHUTDOWNS



Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

Yes, they're all important. But when you're dealing with steam under pressure, *there's nothing more important than reliability—freedom from shutdowns.*

The high factor of safety in Yarway Gun-Pakt Expansion Joints prevents shutdown losses—eliminates accident hazards.

Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.

FEWER JOINTS NEEDED

With Yarway Gun-Pakt Joints you need fewer joints per length of pipe line. Each sliding sleeve may have a traverse of either 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

Gun-Pakt is more than just another expansion joint—it is a revolutionary idea in expansion joint engineering. Its success is shown by wide use in leading central heating stations, institutions and industrial plants.

Get the full Gun-Pakt story . . . get Yarway Bulletin EJ-1912. Write to . . .

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Pa.

Branch Offices in all Principal Cities

GUN-PAKT EXPANSION JOINT

Controlled

the next Big step forward in AMERICAN POWER GENERATING PRACTICE

Within three decades the electric utility industry has reduced its average heat rate by 65 per cent – from about 40,000 Btu per kw-hr to about 14,000. And rates approximating 9000 are indicated for the most efficient stations now being designed.

On the steam generating side, this amazing progress is attributable to certain major advances of the period. These include . . .

- pulverized coal firing
- water-cooled furnaces
- preheated combustion air
- integrated boiler unit designs
- higher pressures
- higher temperatures
- improved firing equipment
- reheat
- improved methods and means of control

Combustion Engineering–Superheater, Inc., has been prominently identified with all these advances.

With this background Combustion offers the principle of controlled circulation as the next big step forward in power station practice. It does so with the confidence born of more than 10 years of development and operating experience. That this confidence is shared by leading utility engineers and their consultants is evidenced by the following contracts, placed since mid-1950, for . . .

eighteen C-E Controlled Circulation Boilers to serve an aggregate capacity of 2,500,000 kilowatts.

Company and Main Office	Station	Capacity per unit lb of steam per hr	Design Pressure	Steam Temp. primary-reheat
Cleveland Electric Illuminating Co., Cleveland, Ohio	East Lake	875,000	2030	1000 – 1000
Consumers Power Co., Jackson, Michigan	Weadock	1,050,000	2300	1050 – 1000
Duke Power Company, Charlotte, North Carolina	Buck	900,000	2010	1000 – 1000
Philadelphia Electric Company, Philadelphia, Penna.	Cromby	1,450,000	2075	1000 – 1000
Public Service Electric & Gas Co., Newark, New Jersey	Kearny	1,015,000	2650	1100 – 1050
Southern California Edison Co., Los Angeles, Calif.	Etiwanda	920,000	2100	1000 – 1000
Virginia Electric & Power Co., Richmond, Virginia	Chesterfield	750,000	1670	1000 – 1000
	Gilmerton	750,000	1670	1000 – 1000
Wisconsin Electric Power Co., Milwaukee, Wisconsin	Oak Creek	795,000	2050	1050 – 1000

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Circulation

ADVANTAGES

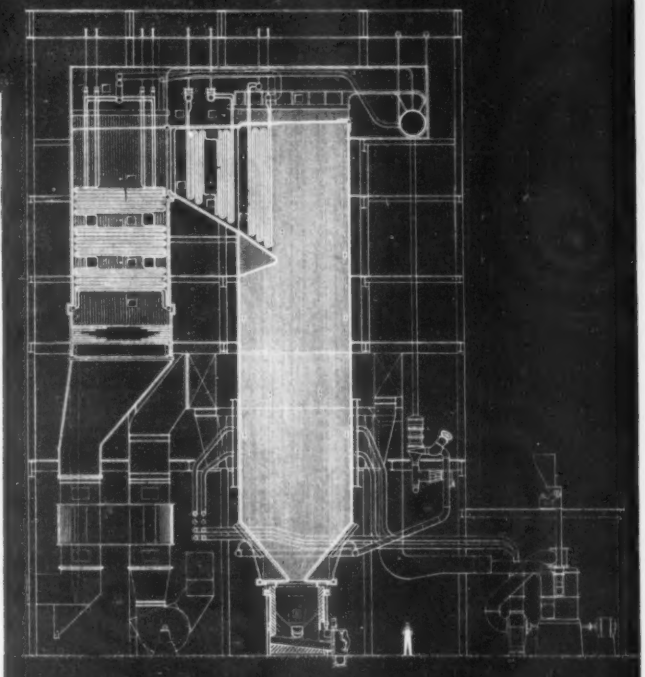
The major characteristics of the C-E Controlled Circulation Boiler are (1) the maintenance of positive, high velocity circulation in all circuits, under all operating conditions, (2) the proper proportioning of water supply to all heating circuits, and (3) the use of small-diameter, thin-wall tubes. These characteristics provide many design and operating advantages, the principal ones being:

DESIGN

- Permits the use of pressures considerably beyond the practical limits of natural circulation boilers
- Introduces new flexibility in proportioning of unit to fit existing space conditions or to reduce height and therefore cost of new plant structures
- Permits the use of bare furnace walls regardless of pressure
- Provides a substantial reduction in weight of pressure parts, and therefore of structural supports

OPERATION

- Maximum availability
- Faster pick-up or drop of load
- Reduced outage time for inspection or maintenance
- Higher plant safety factor



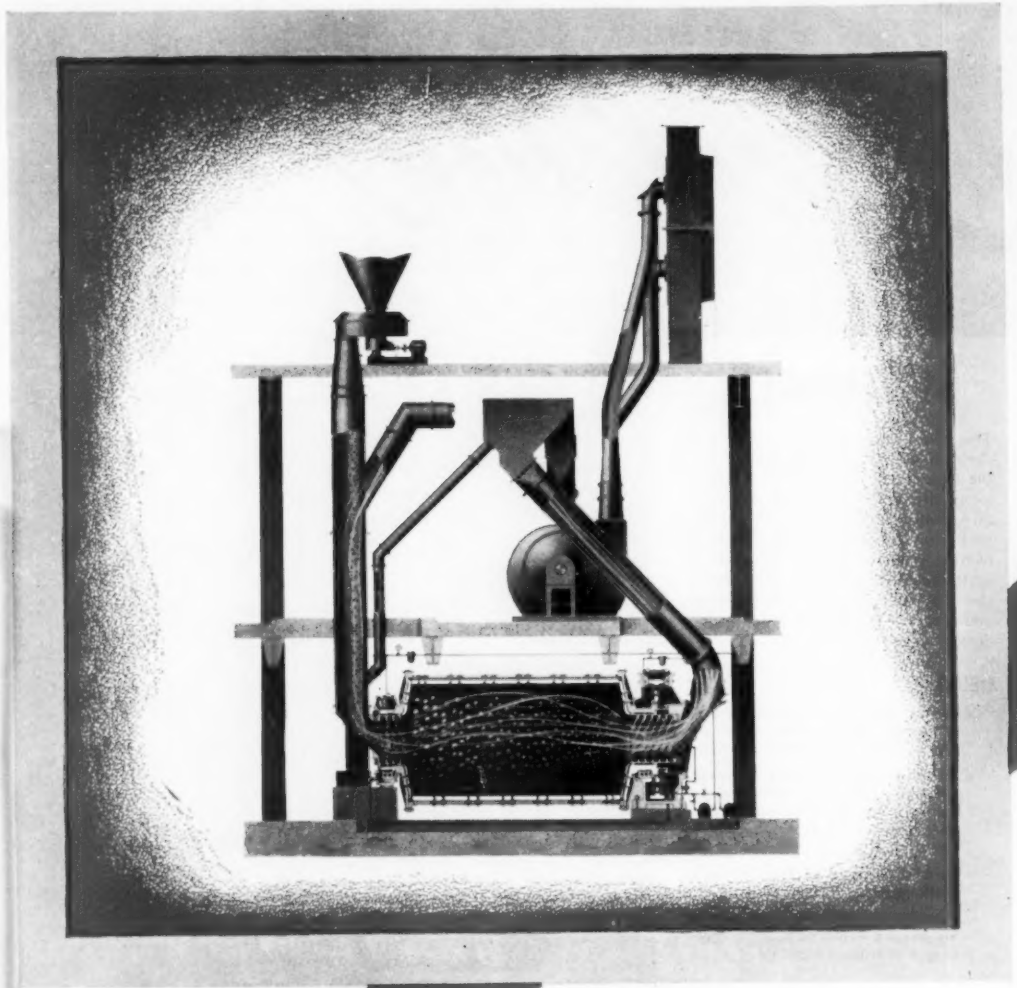
Sectional elevation of typical C-E Controlled Circulation Boiler.

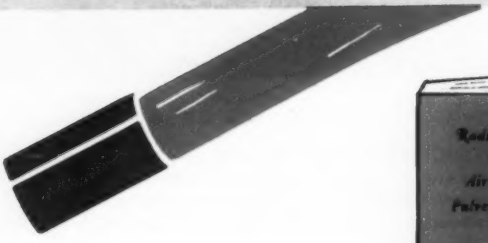
PREDICTION: The decade of the fifties will be marked by the ever increasing recognition of controlled circulation as a major advance in power station practice and by its wide adoption for the higher range of pressures.

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E





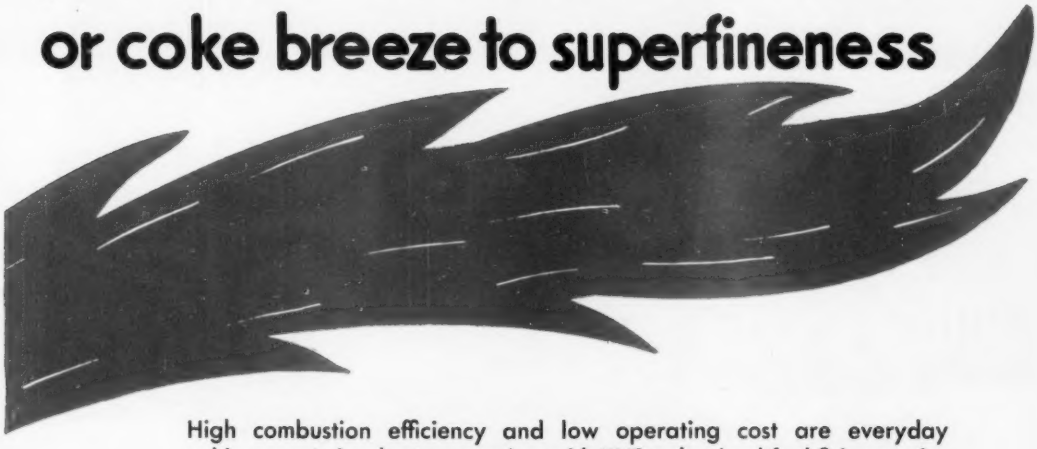
All components of KVS Steam Generating Units are engineered to meet specific operating conditions and to assure the maximum in efficiency and economy at all boiler ratings. Send for a copy of Engineering Bulletin No. 44-B containing valuable information on coal preparation and steam generation.

KVS is equipped to design and build complete power plants from "bunker to bus bar" in any part of the World and assume full responsibility for overall performance guarantees of all equipment whether or not built in KVS shops.

KVS ENGINEERING SERVICE

KVS AIR SWEPT TUBE MILLS

pulverize bituminous, anthracite or coke breeze to superfineness



High combustion efficiency and low operating cost are everyday achievements in plants operating with KVS pulverized fuel firing equipment. Furthermore, worthwhile savings on the fuel bill are being made regardless of the fuel, because, with the KVS Air Swept Tube Mill, a superfine fuel is provided from any coal with firing rate under complete control at all times.

Ability of KVS Air Swept Tube Mills to prepare all grades of coal for combustion of low power and maintenance costs is the result of the method employed for pulverization. This is accomplished by throwing down a continuous cascade of steel balls on the coal, completely pulverizing it and then floating out the resulting impalpable coal powder by means of air, fandrawn through the mill.

The fact that any coal can be pulverized to extreme fineness assures wide latitude in selecting the coal best suited to plant location and specific operating conditions.

Kennedy-Van Saun

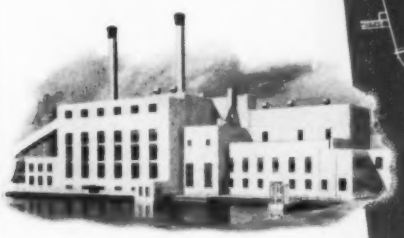
MANUFACTURING AND ENGINEERING CORPORATION

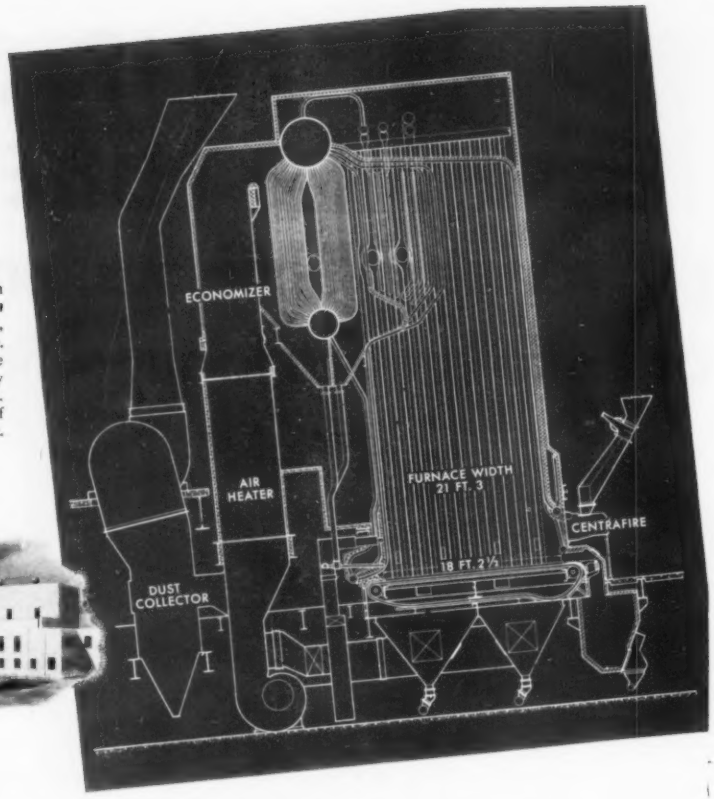
2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

Engineers for the Bay Front Steam Plant of the **Lake Superior District Power Company** at Ashland, Wisconsin, were **Sargent & Lundy**. The Westinghouse Centrafire with Traveling Grate will carry a constant load of 200,000 lbs. of steam per hour, with peaks of 230,000 lbs. of steam per hour.





CONSTANT LOAD 200,000 lbs. per HOUR... another Centrafire triumph!

The Westinghouse Centrafire® with Traveling Grate now being installed for the Lake Superior District Power Company is one of the largest Centrafire units that has been ordered to date. This utility and their consulting engineers wanted a stoker that could maintain a constant load of 200,000 lbs. of steam per hour . . . with peaks of 230,000 lbs. of steam per hour . . . despite continuous feeding of wet and storage coal. Moreover, they needed a stoker that could absorb foreign objects in the coal, without interruption or damage to the apparatus.

The ability of the Centrafire to "take it" and continue without load loss under severe conditions has been demonstrated in factory tests and in power plant installations. Wet coal, storage coal, bricks, blocks of wood, insulators, cable, bolts and many other foreign objects have been deliberately introduced into the feeders with no adverse effect.

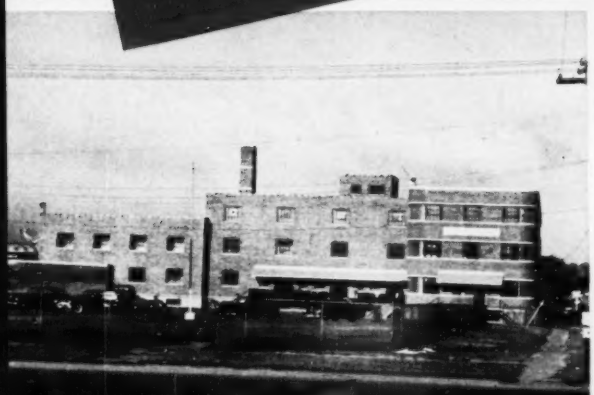
There are many other features that make the Centrafire outstanding . . . they're built into the basic design, not added as accessories. Whether your application calls for 50,000 lbs. of steam per hour . . . or 350,000 . . . the Centrafire with Traveling Grate offers advantages you should investigate. Call your nearby Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-50537

YOU CAN BE SURE... IF IT'S
Westinghouse
STOKERS

Now more important than ever to you...

Fast LOCAL delivery



Convenient LOCAL warehouses

On-the-spot LOCAL lubrication engineering

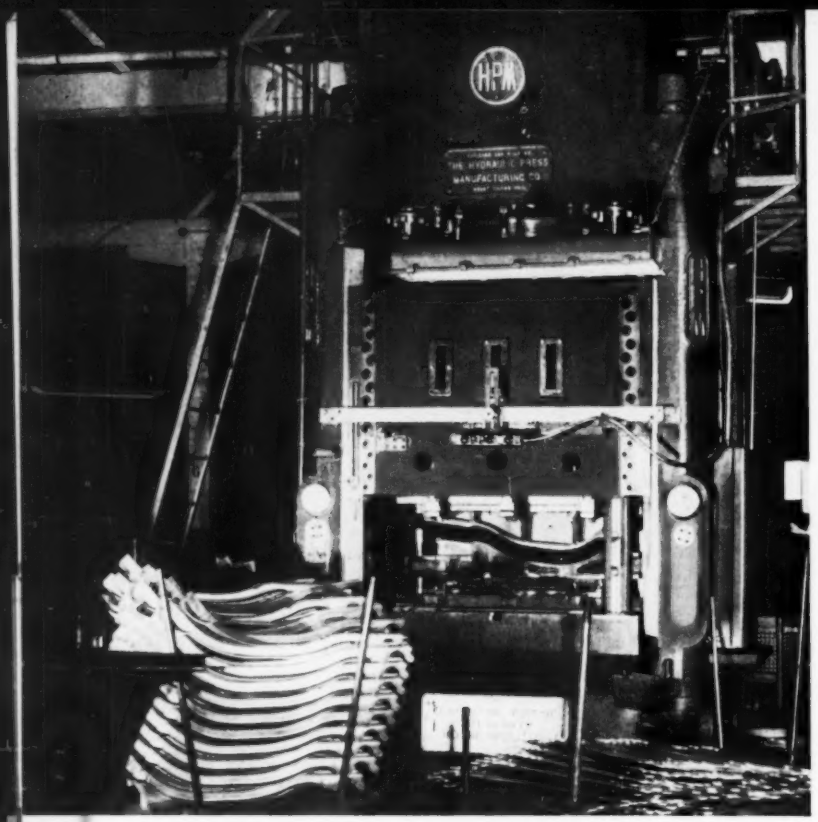
Standard's LOCAL Lubrication service

• Wherever you are located in the Midwest, there's a Standard service-supply center close at hand. That means prompt delivery of Standard products, immediate assistance from a Standard lubrication specialist.

There's no need to worry over possible production delays due to lack of the right cutting oil, lubricant, or fuel . . . no need to stock-pile these supplies in your own plant . . . no need to wait for help in solving your lubrication problems.

To take advantage of Standard's time-saving *local* lubrication service (now more important than ever to you) call the Standard office in your area. Or write: Standard Oil Company (Ind.), 910 South Michigan Avenue, Chicago 80, Ill.

STANDARD OIL COMPANY (INDIANA)



What's YOUR problem?

D. G. Cripps, of Standard Oil's Grand Rapids, Michigan, office, is the Standard Oil lubrication specialist who recommended STANOIL for use in the hydraulic press shown at the left.

Complete familiarity with job requirements and lubrication applications equips a corps of such Standard Oil lubrication specialists throughout the Midwest to handle similar problems for plant operators.

One of these lubrication specialists is near your plant – ready to give you the benefit of his experience and training. You can obtain his services quickly and easily. Just phone or drop a card to the nearest Standard Oil Company (Indiana) office. Ask the lubrication specialist to explain the benefits of such widely accepted lubricants as:

SUPERLA Greases—Available in all consistency grades, SUPERLA Greases cover a wide range of applications. These products are comparable in quality to the highest type of special greases but are as readily available and economical as ordinary cup greases.

CALUMET Viscous Lubricants—On open gears and wire rope, these greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of gears and chains, better internal lubrication of wire rope.

STANORUST Rust Preventives—The eight grades of STANORUST form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically and specifically developed for its intended use. The grades range from a finger print remover to a heavy petrolatum that protects against corrosion for years under the most severe outdoor exposure.

Gain these benefits for your hydraulic operations

The big 400-ton hydraulic press shown above is used to stamp out parts for farm machinery in a big midwest plant.

When the press was first put into operation, plant operators followed the recommendation of a Standard Oil lubrication specialist and used STANOIL Industrial Oil in the hydraulic system. In over four years of continuous hard service, there has been no lost time because of inefficient performance of the hydraulic oil.

Oil capacity of the system is approximately 9 barrels; only 2 barrels make-up per year has been required. The oil in this system has never been changed. It has been centrifuged once to remove moisture which accumulated over three years' operation. Periodic tests of oil samples have shown that STANOIL has maintained its high lubricating quality. A recent analysis showed no increase in viscosity of the oil, no change in color, and a neutralization number of only 0.13 mg. KOH/gm.

You can rely on this unique many-purpose

STANOIL
TRADE MARK
Industrial Oil

oil to give you the same clean, dependable service in your plant's hydraulic systems, speed reducers, head stock gears, auxiliary turbines, compressors, and electric motors. You can rely, too, on the expert, on-the-spot service of a Standard Oil lubrication specialist. How you can obtain his help, quickly and easily, is explained at the right.

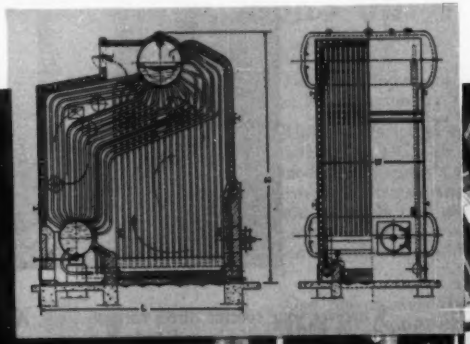
Standard Oil Company, 910 So. Michigan, Chicago 80, Illinois.

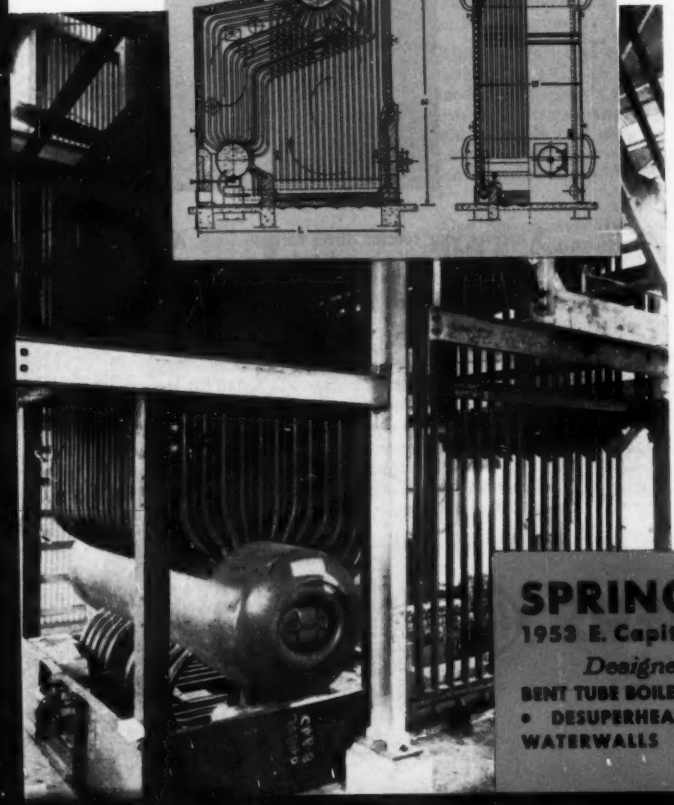
STANDARD OIL COMPANY (INDIANA) STANDARD

Popular Choice!

SPRINGFIELD TYPE C *Standardized* 2-Drum Boilers

Across the country, leading industrial plants have made Springfield Type C 2-Drum Boilers THE POPULAR CHOICE where steam is needed for power, process, or heating service! Because these advanced designs are produced in a wide range of *standard* sizes, delivery time and engineering costs are held to a minimum. Users get many advantages: Positive Circulation...High Reliability...Water Cooled Furnace...Dry Steam—steam delivery tubes discharge above water level...AND *good efficiency with any type of fuel you want to burn!* Superheater, economizer, and air heater, if desired. For quotations and information, see your local Springfield representative or write us TODAY.





CEREAL MAKER—30,000 lb. Springfield Type C unit for America's largest manufacturer of cereals and grain food products. Oil and gas fired. *Location: Belmond, Iowa.*

LUMBER MILL—Two 65,000 lb. Springfield Type C units for large West Coast lumber company. Designed for firing with wood waste. *Location: Gardiner, Oregon.*

INSULATING MATERIALS—50,000 lb. Springfield Type C unit for insulation maker. Spreader stoker firing. Operating pressure, 250 psi. *Location: Dubuque, Iowa.*

BUILDING MATERIALS—30,000 lb. Springfield Type C unit for well-known maker of pressed sheathing and board. Gas and oil firing to 450 psi. *Location: Los Angeles, California.*

PLYWOOD PLANT—30,000 lb. Springfield Type C unit for western plywood mill. Designed for firing with wood waste. *Location: Portland, Oregon.*

STEEL MILL—35,000 lb. Springfield Type C unit for maker of steel forgings. Spreader stoker firing. Operating pressure 160. psi. *Location: Gary, Indiana.*

SPRINGFIELD BOILER CO.

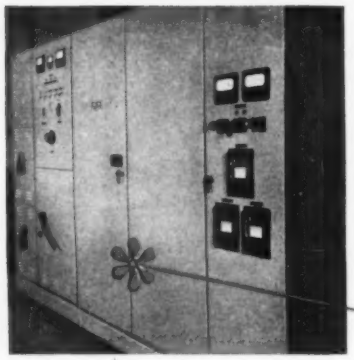
1952 E. Capitol Avenue • Springfield, Illinois

Designers, Fabricators and Erectors of

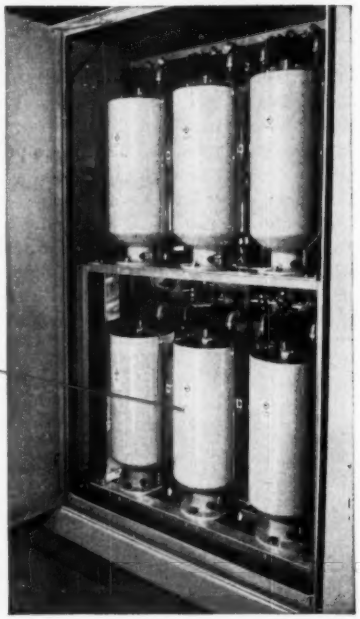
BENT TUBE BOILERS • STRAIGHT TUBE BOILERS • SUPERHEATERS • DESUPERHEATERS • AIR HEATERS • ECONOMIZERS • WATERWALLS • COMPLETE STEAM GENERATING UNITS

Don't build around obsolete DC supply

—RETIRE IT NOW!



Modern Allis-Chalmers factory packaged, sealed tube, 500 kw mercury arc rectifier as installed in midwestern industrial plant. Left: "dead-front" compartments for dc feeders, dc metering and cathode breaker, rectifier tubes, and ac control and metering. Right: interior view of mercury arc rectifier tube compartment.



NOW IS THE TIME to retire obsolete converting and generating equipment. As operations expand, this inadequate equipment will become a growing handicap.

Now too — while there is a favorable base for amortization — is the time to consider mercury arc rectifiers for your expansion plans. Let Allis-Chalmers show you how the *modern* mercury arc rectifier can improve your direct current service.

LOW MANPOWER REQUIREMENT. With push-button starting and no synchronizing required, attendants are not needed during normal operation. Downtime for maintenance is reduced with no moving parts to lubricate or wear.

LOW COST OPERATION. Conversion efficiency is higher at all loads with large power savings during light load periods.

CONVENIENT INSTALLATION. Factory packaged, light in weight, and requiring no special foundation, Allis-Chalmers mercury arc rectifiers may be placed right at the load center.

IMPROVED PLANT OPERATION. With dc load center installation, distribution distances are cut, dc feeder losses are reduced, and full voltage is available at production equipment.

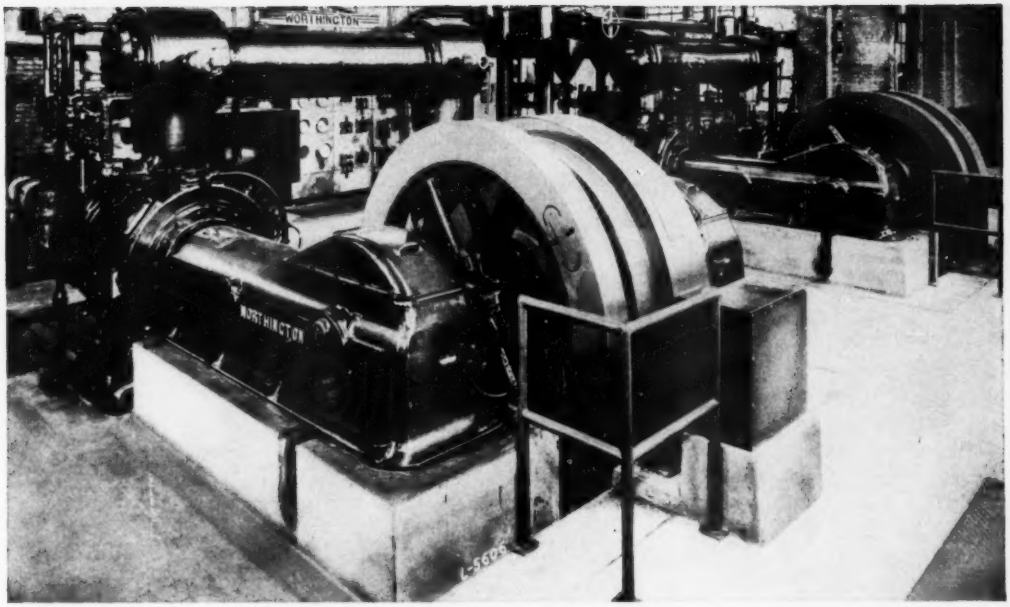
Whatever your specific direct current needs, Allis-Chalmers builds suitable and truly modern mercury arc rectifiers to meet them.

Sealed tube rectifiers (as shown above) are supplied in ratings from 200 to 1000 kw for lighter duty service. These are commonly used in large buildings, industrial plants and electric haulage systems. Pump evacuated rectifiers are built from 750 kw to the largest ratings required for heavy duty applications.

An Allis-Chalmers representative will be glad to explain in detail how these modern mercury arc rectifiers will improve the operation of *your* direct current system. Call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3467

ALLIS-CHALMERS A-C **MERCURY ARC RECTIFIERS**



Link-Belt "Hooks Up" with Worthington Air

You can't find a compressed air need that Worthington can't fill.

This installation pictured above is a Worthington DC2 air compressor in Link-Belt Company's Pershing Road plant in Chicago. And that picture could be duplicated all over America where engineering-wise plants insist upon dependable, trouble-free, low-cost air.

One reason is—*only* Worthington makes air compressors with the Feather* Valve. Any other valve is complicated beside this Worthington exclusive. Feather* Valve is the simplest, lightest, most efficient ever made.

Then there's Worthington automatic variable capacity control—acknowledged the most accurate, flexible and simple control obtainable. And Worthington's high-efficiency intercooler that needs less water, less power, less attention.

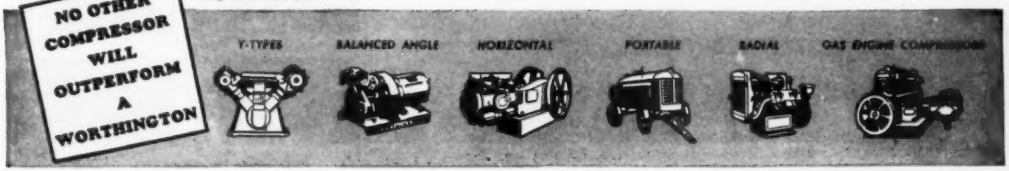
Build around these features with sturdy construction . . . back up the machinery with Worthington application engineering—and you have plenty of reasons for deciding *there's more worth in Worthington*. Worthington makes all auxiliary equipment, too. Write for bulletin L675 B-1B to Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.

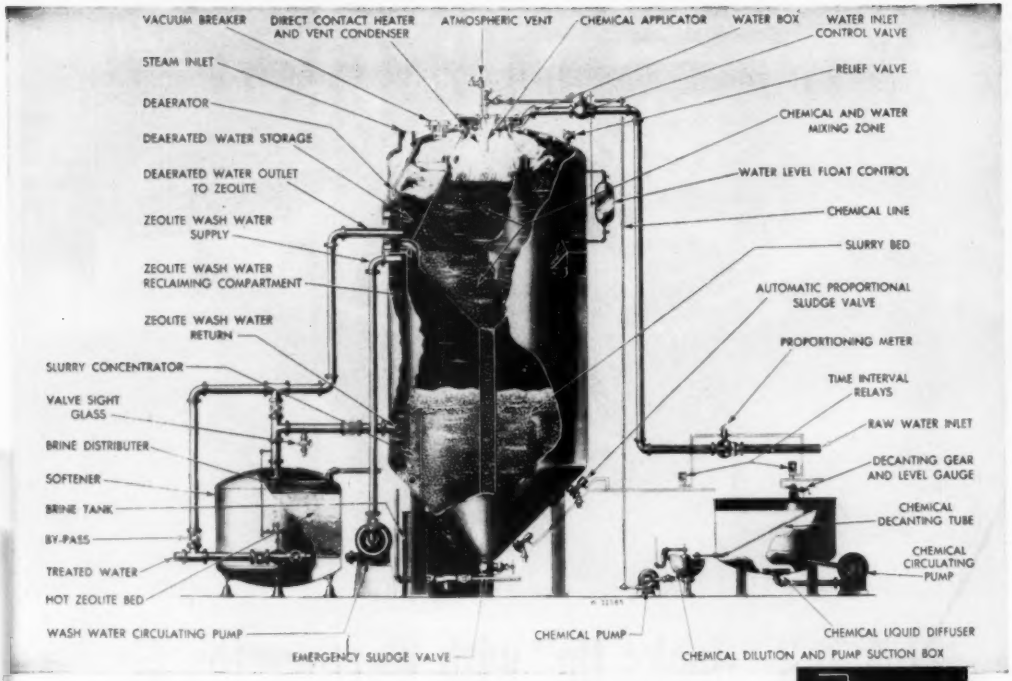
WORTHINGTON

*Reg. U. S. Pat. Off.

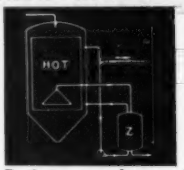
K1.9

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON





Here's how to make water softening a soft job for you



You have less to do . . . to worry about . . . to pay for—when you use Worthington's revolutionary Hot-Z Slurry-Type Deaerating Water Softener.

It combines all the best features of Hot Process and Zeolite, plus these Worthington-originated features:

No more scaling trouble. Direct-contact vent condenser eliminates scaling trouble experienced with old-fashioned shell-and-tube types.

Supervision reduced. Concentrated sludge is removed automatically and proportionately to water volume.

Assures uniformity. Hydraulic chemical mixer assures uniformity of chemical strength. Also saves space.

Easier cleaning of valve-type wash water sight glass.

Better deaeration. Steam-jet deaeration is simpler, gives better efficiency—removes oxygen to .005 cc per litre.

Independent backwash system. Built-in annular wash water compartment provides clear hot water for backwashing and reclaims it without affecting operating velocities in treating zone. This feature not only pays off in systems employing filters, but also is ideal for backwashing the hot zeolite.

You also save because Worthington Hot-Z Systems operate on low-priced lime and salt. The average installation saves enough in chemical costs to pay for itself in 3 years!

Get all the facts!

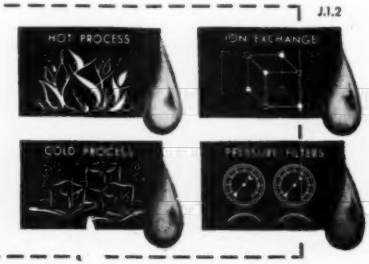
It will pay you to investigate the Worthington Hot-Z System thoroughly. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find *there's more worth in Worthington.* Worthington Pump and Machinery Corporation, Water Treating Section, Dunnellen, N. J.

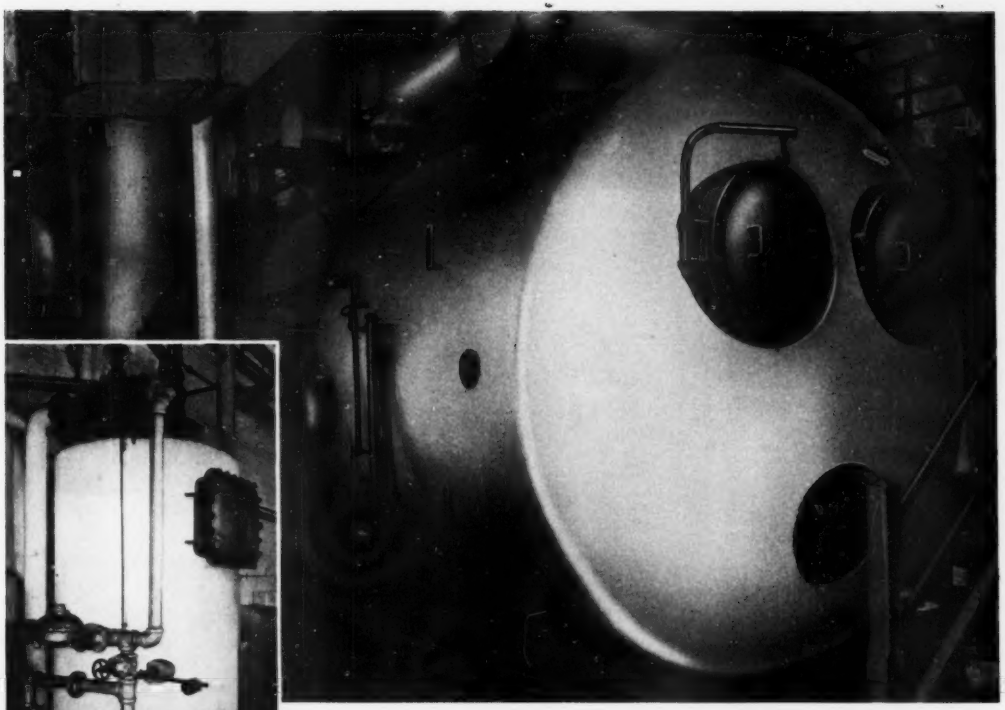
J.1.2

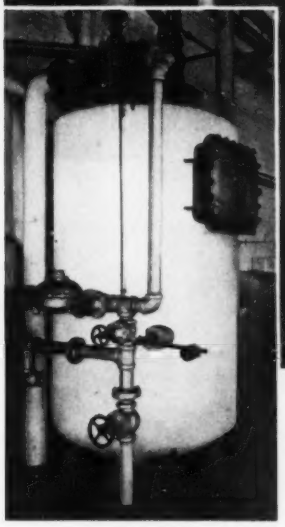
WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems







A Big Help

on small—as well as big—deaeration jobs

Small deaerators are big business at Worthington! That's why the plant with small-capacity requirements will benefit by getting acquainted with the complete range of Worthington deaerating equipment.

Worthington Gives You All Types, All Sizes

Worthington deaerating heaters and deaerators are built in sizes to handle from a few thousand pounds an hour to over a million. They are tailor-made to fit the particular requirements of each job. Special designs are available for operation with scale-forming water.

Both tray and steam-jet types are made—with external surface-type vent condensers or internal direct-contact vent condensing. They can be furnished for any practical operating pressure—constant or variable—or for vacuum operation.

With a complete range of sizes and types at their fingertips, Worthington engineers can competently recommend the design best suited to *your* requirements.

Remember, too, Worthington designs are backed by over 50 years experience in the design and manufacture of direct contact feedwater heaters and over 100 years experience in hydraulic machinery.

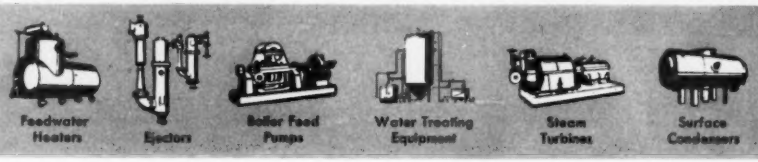
Send your water treating problem to Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

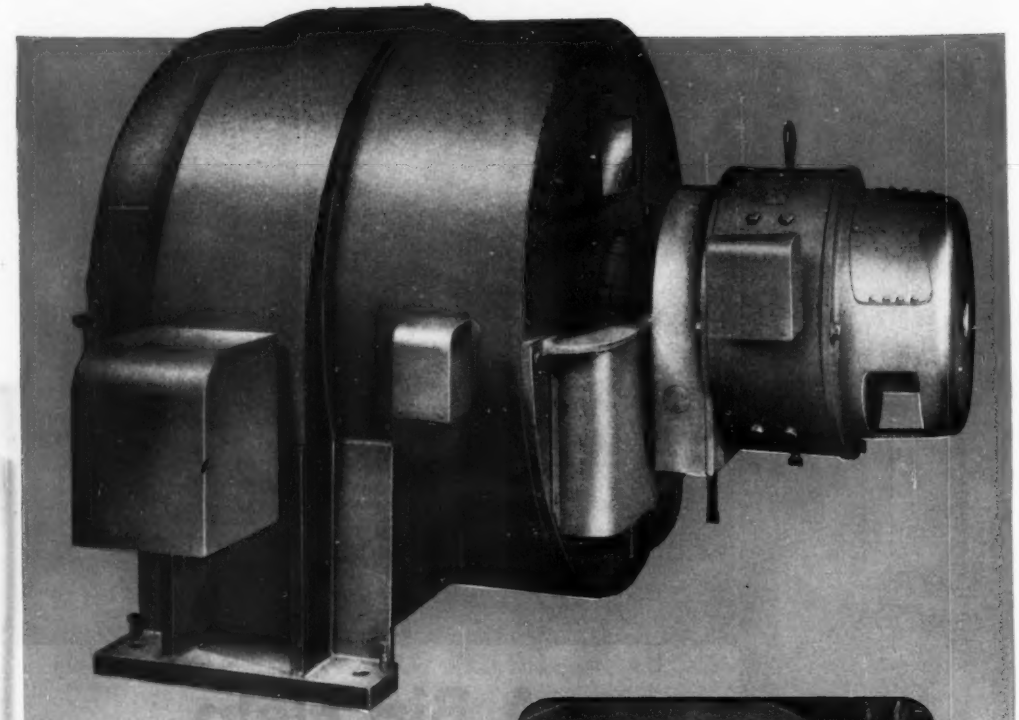
WORTHINGTON

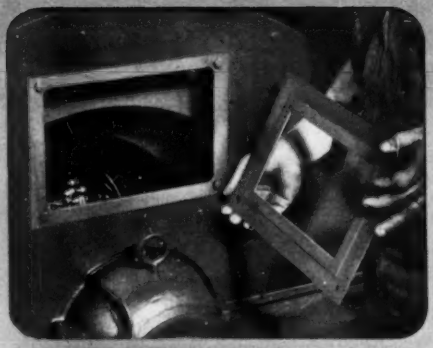
DEAERATORS

S.1.5

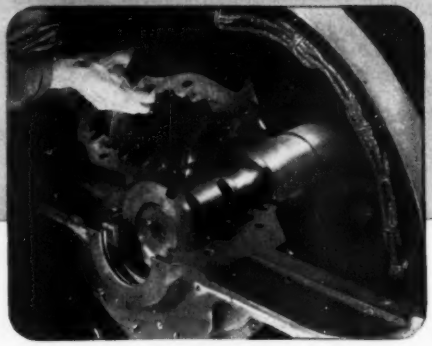
A GREAT TEAM IN STEAM







Window makes brush inspection easy. Remove window for quick entrance to brushes . . . for checking and inspection. At a glance you can see operation of brushes on rings.



No top half of bracket to remove—only top half of bearing housing. Lower half is integral with bracket. Bearing can be removed without disturbing bracket mounting. Light, sturdy end covers and air shields are easily and quickly removed. No crane is required. One man can do the job easily.

MORE POWER PER DOLLAR

Synchronous Motor Design Speeds Servicing

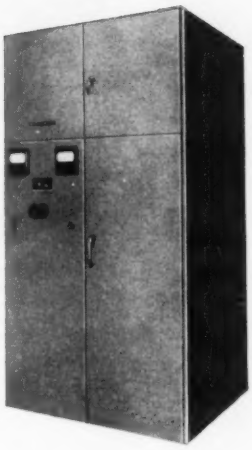
A new kind of maintenance simplicity is built into this line of Synchronous Motors. You can see for yourself in the pictures at the left. Notice the split sleeve bearing housing. Gone is the need for removing the top half of the bracket. Simply remove top half of bearing housing. It can be done by hand. End covers, too, are quickly removed for complete inspection, cleaning, or other servicing requirements. They're light—can be removed by hand.

Brush servicing time is greatly reduced by the window at the collector ring end of the motor. Visual inspection—without disturbing motor—is now possible. When brush replacement is required, simply remove the window and you can get at the brushes without disturbing end brackets or shields.

Considering the ease of maintenance . . . the lower first costs . . . the improvement of power factors, Synchronous Motors supply more power per dollar than any other type of motor. Considering the design features, the fifty years' experience in building motors, Westinghouse offers more motor per dollar.

Ask your Westinghouse representative to show you how Synchronous Motors and Controls can save you money. Call him today, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-10353



Matched control for the motor. This Slipsyn Synchronous Motor Control protects your motor investment . . . helps you get more for your power dollar.

YOU CAN BE SURE... IF IT'S

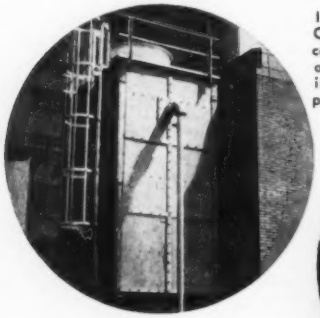
Westinghouse

SYNCHRONOUS MOTORS AND CONTROLS

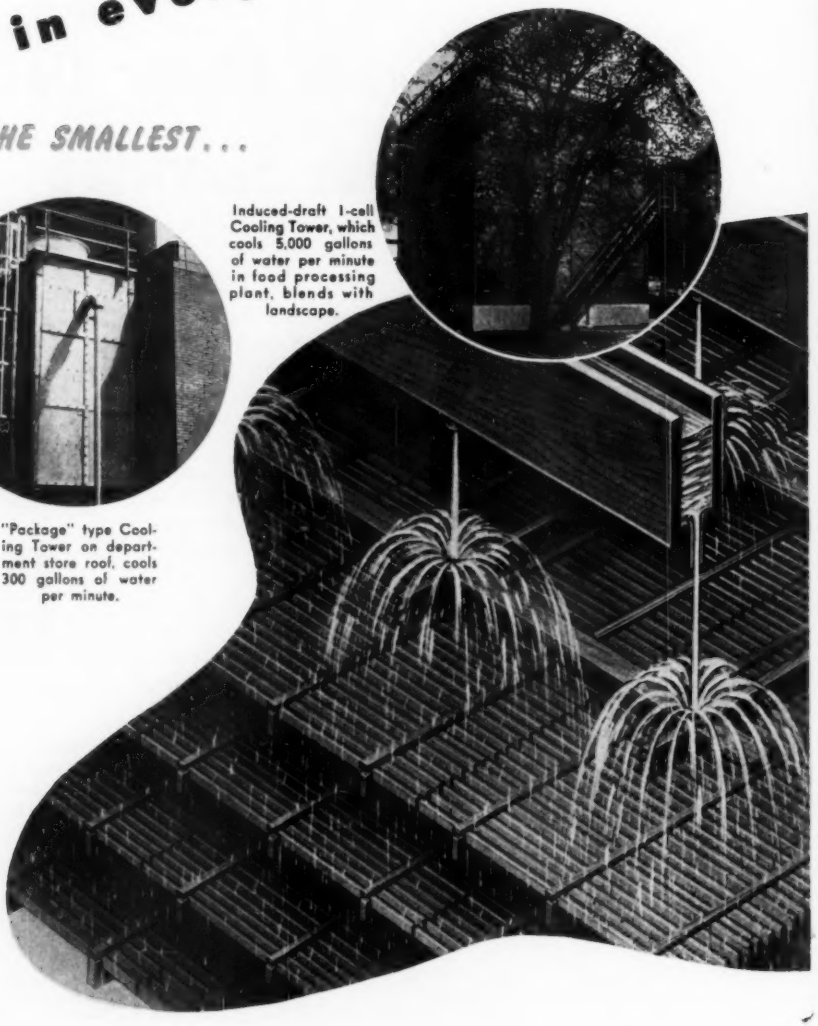
the same engineering excellence

in every Foster Wheeler

FROM THE SMALLEST...



"Package" type Cooling Tower on department store roof, cools 300 gallons of water per minute.

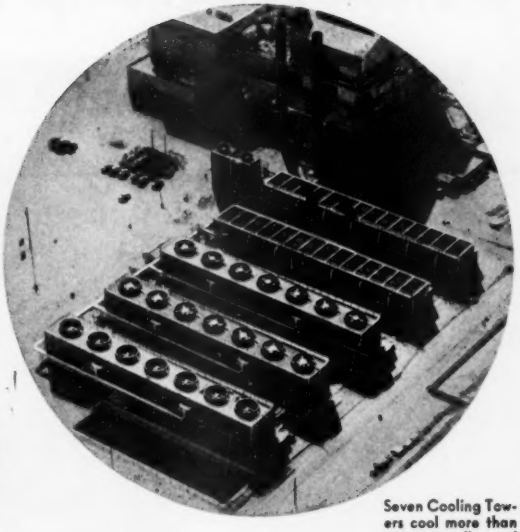


Induced-draft 1-cell Cooling Tower, which cools 5,000 gallons of water per minute in food processing plant, blends with landscape.

FOSTER WHEELER CORPORATION 165 BROADWAY

cooling tower

Induced-draft Cooling Tower in oil refinery cools 15,000 gallons of water per minute to within five degrees of the design wet bulb.



Seven Cooling Towers cool more than 180,000 gallons of water per minute in large power plant.

. . . TO THE LARGEST

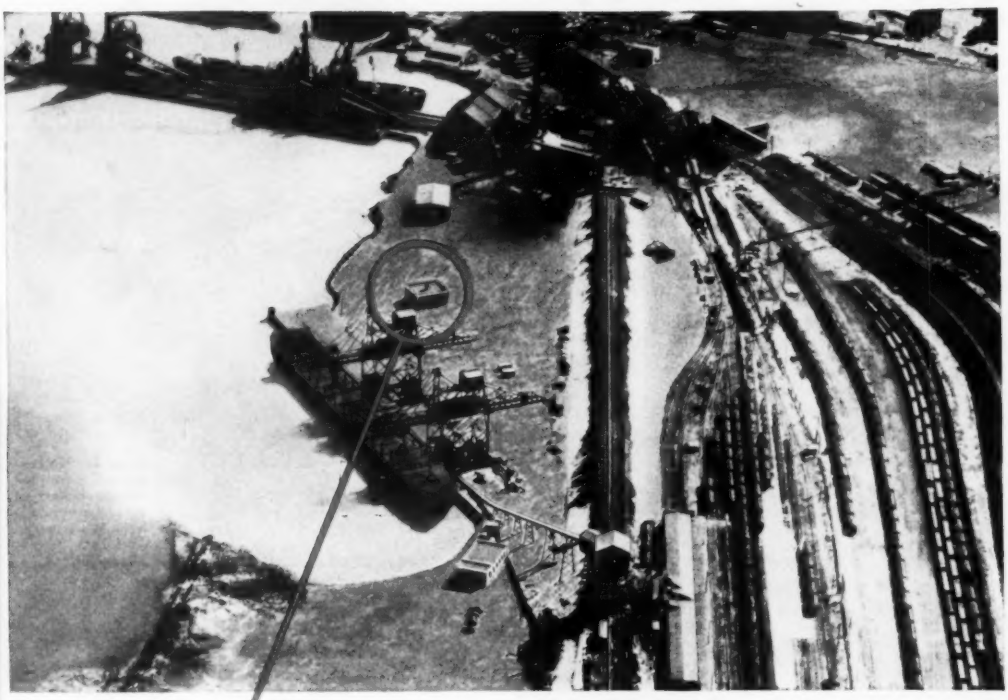
Whatever the application—a "package" type on a department store roof in New York City, a twenty-cell tower for a power plant in Arkansas, or a large unit for a chemical plant in India, Foster Wheeler Cooling Towers can be depended on to deliver full capacity in year-round service.

A Foster Wheeler Cooling Tower is your best guarantee of a constant supply of cooling water for steam power plants, processing, air conditioning, or other uses. Regardless of size, the same engineering and construction excellence, the same attention to detail and the same quality of materials go into every Foster Wheeler installation.

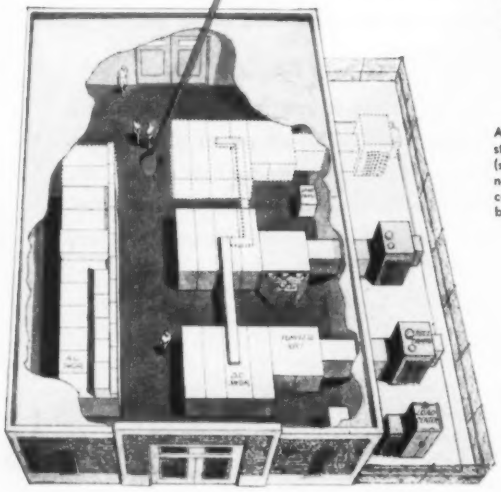
NEW YORK 6, NEW YORK

FOSTER WHEELER

G-E switchgear protects operation



Aerial view of the new Baltimore and Ohio ore facility in the Curtis Bay section of the Port of Baltimore. Circled building marks location of the modern G-E substation equipment which supplies power for the two unloaders and two General Electric pusher locomotives that are used to spot gondola cars for loading.



Artist's drawing of the G-E substation showing two 1000 kw d-c substations, a-c substation and metal-clad switchgear. Additional units (sketched in phantom form) show location of the equipment that will be needed for future plans which call for doubling the present unloading capacity. Another d-c load center and two more switchgear units will be needed.

# of new $5,000,000 investment!

New B&O unloaders move 2000 tons an hour around-the-clock. Continuous power supplied with modern d-c substation and metal-clad switchgear.

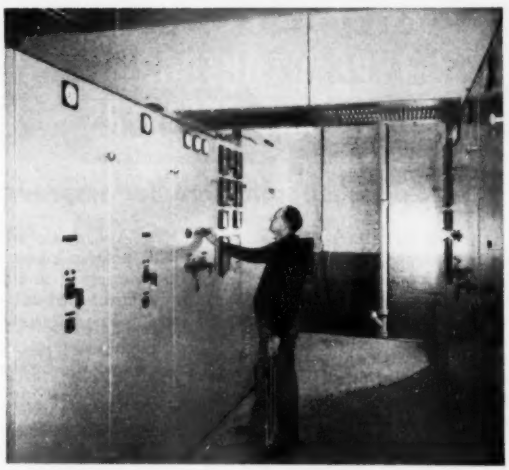
Strategic ore from Liberia and South America takes less time to get to the nation's steel producing centers when it is unloaded at the Baltimore and Ohio's new ore facility in the Curtis Bay section of the Port of Baltimore.

Incorporating the latest improvements in design and equipment, the new ore dock has a working capacity of 2000 tons an hour. The two highly efficient unloaders reduce turn-around time for ore boats and provide an almost continuous stream of ore-laden railroad cars for iron and steel mills. These same cars return to Baltimore loaded with coal, give B & O a two-way pay load for greater efficiency.

Continuous power for 24-hour operation is supplied by modern G-E substations. Two 1000 kw d-c substations supply the main power for the entire installation, while an a-c substation supplies auxiliary power and lighting. G-E metal-clad switchgear provides control and protection for the incoming and outgoing feeders to a-c and d-c load centers.

Forward-looking G-E engineers are ready to apply the knowledge gained from this, and hundreds of other installations, to *your* problems. Investigate today the many advantages of using General Electric switchgear in your plant for efficient, flexible power distribution. Contact your G-E sales representative, or write for bulletin GEA-3083 Metal-clad switchgear. General Electric Company, Schenectady 5, N. Y.

G-E metal-clad switchgear for the 13.2 kv feeders to a-c and d-c substations. All components are metal-enclosed for protection to personnel. Because units are factory-built and arrive ready to install, total installed cost is greatly reduced.



View of the operating aisle of the d-c substation. New G-E pumpless rectifiers provide continuous low-cost d-c power conversion. Minimum number of moving parts reduces maintenance. All parts are easily accessible.

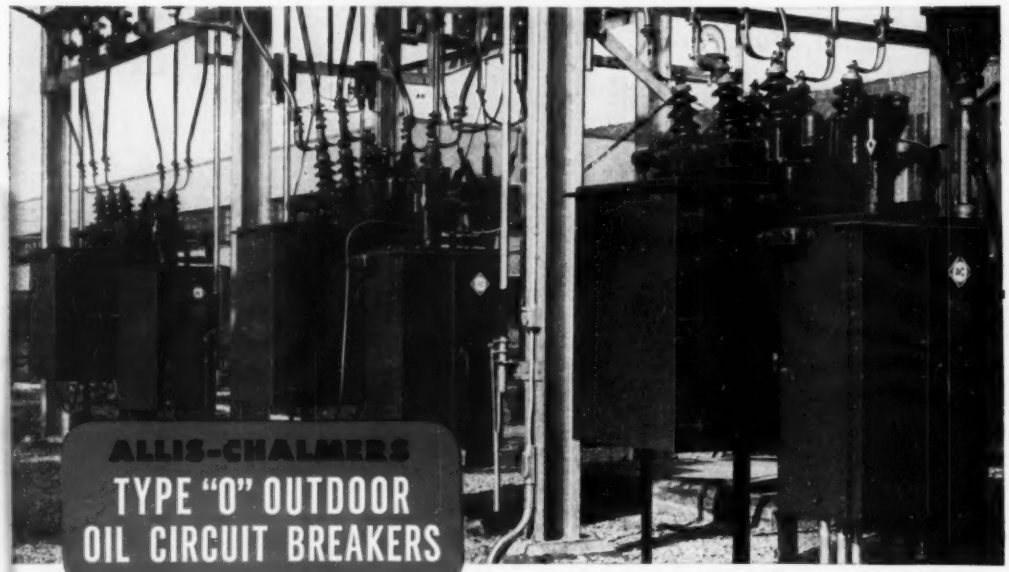
GENERAL ELECTRIC

854-38

Dependable

ELECTRICAL PROTECTION

FOR DISTRIBUTION SYSTEMS



Packaged complete for improved automatic reclosing service

ALL YOU NEED to order your type "O" breaker is one set of specifications. It's simple and convenient. This standard 3-pole breaker comes to you mounted on a strong lightweight framework with operating mechanism and automatic reclosing equipment each in its own weatherproof housing. The type "O" breaker is factory assembled, wired and tested in accordance with ASA standards . . . ready to install and operate.

SECURE THESE PROVEN ADVANTAGES

1 **Positive, high speed breaker action with mechanically and electrically trip-free solenoid operating mechanism, ac or dc operation as specified.**

2 **Efficient circuit interruption with high rate of dielectric recovery for low contact and oil deterioration.**

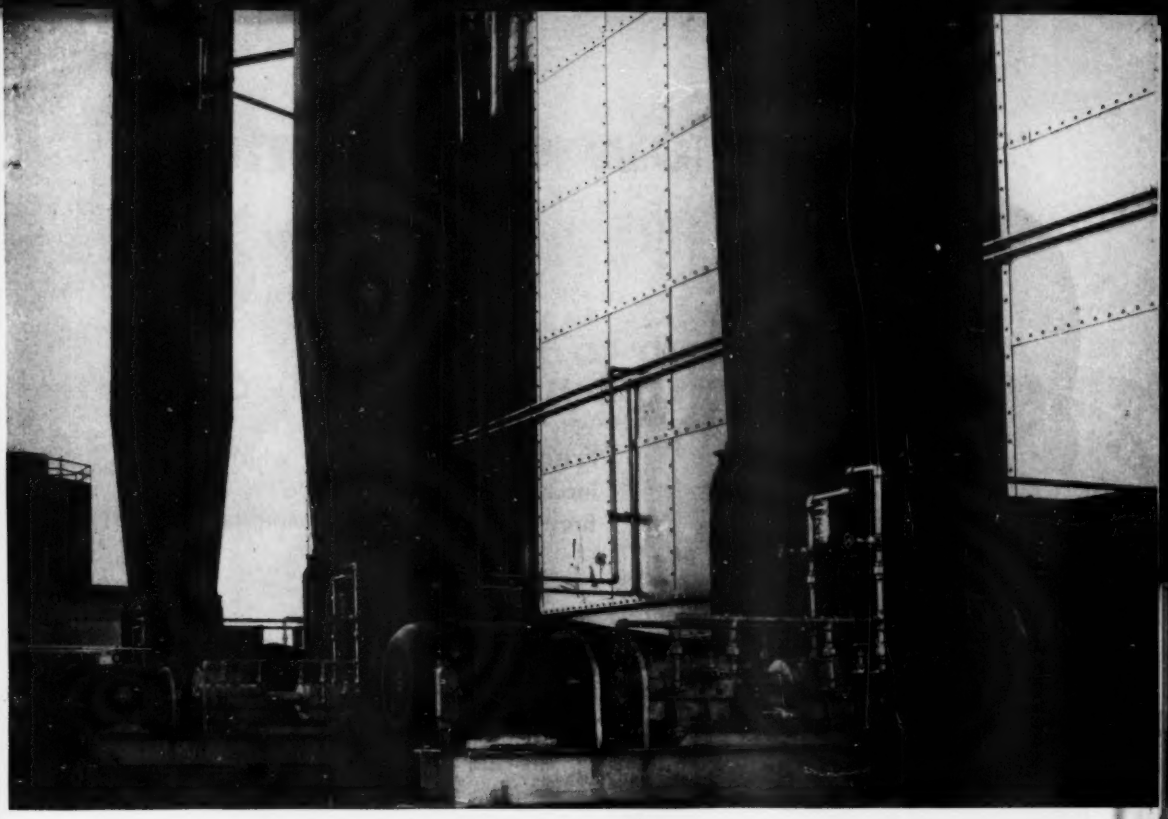
3 **Automatic reclosing duty for unattended stations with standard protective and reclosing relay equipment included.**

Feature for feature you cannot buy better breakers in this class. Over 50 years of Allis-Chalmers progress in power circuit breakers is built into them. You can install them with complete confidence. For more information call your local A-C sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for bulletins 71B6165A (OX-18) or 71B6093C (OZ-110, OZ-210).

A-3440

Type	Rated KV	Rated Amps. (60 cycle)	Interrupting Capacity KVA
OX-18	7.2	600	50,000
OZ-110	14.4	600	100,000
OZ-210	14.4	600	250,000
OZ-210	14.4	1200	250,000
OZ-210	23	600	250,000

ALLIS-CHALMERS



Husky Housings

SAVED INSTALLATION DOLLARS HERE!

—FURTHER ECONOMIES OFFERED TO YOU IN RUGGED "BUFFALO" INDUCED DRAFT FANS

● This "Buffalo" Induced Draft Fan installation at a prominent Natural Gas Company shows how easily stacks can be mounted on Buffalo fan outlets. The fan housings support the entire weight of the stacks in this economical outdoor installation.

This same rigid, heavy construction pays off in the long, punishing draft job, too. "Buffalo" Induced Draft Fans have extra-heavy housings and blades to stand the continual heat and erosion LONGER. Bearings and shafts are oversize—fully equal to continuous service demands. This means fewer timeouts (and timeouts cost money!). It means fewer repair bills. Yes, "Buffalo" Draft Fans are giving cheaper draft service everywhere because of this inbuilt extra endurance.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in All Principal Cities

Why Not Look

INTO these rugged fans that always save you money in the LONG RUN? Just write for Bulletin 3190-B for all the engineering facts.

"Buffalo" FORCED AND INDUCED DRAFT FAN

How an Engineer

46%

Fred Koenig's notes which were incorporated in his report to the Wagner Brewing Co., Columbus, Ohio, in Oct. 1951.

Cost of new power plant	$128,000
Coal tonnage (old plant)	8,420
Coal tonnage (new plant)	4,700
Fuel costs (old plant)	$ 54,730
Fuel costs (new plant)	$ 32,000
Yearly savings on fuel	$ 22,730
Labor costs (old plant)	$ 41,496
Labor costs (new plant)	$ 19,496
Reduction in present labor costs	$ 22,000
Yearly savings	$ 44,730

Amortization time, new power plant— 2 years, 11 months.

Fred W. Koenig

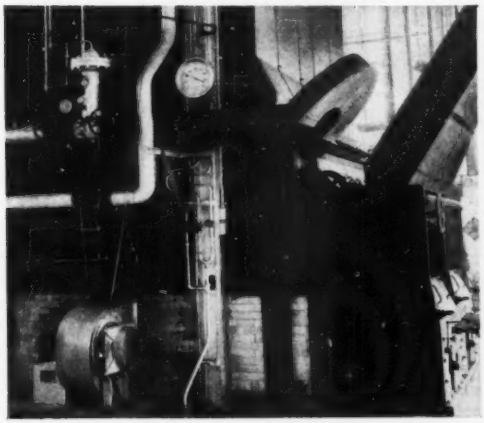
CHIEF ENGINEER
OHIO LICENSE

FOR HIGH EFFICIENCY
FOR LOW COST

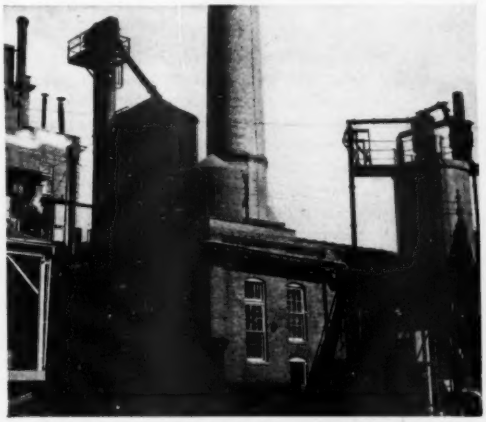
Slashed Operating Costs *with coal!*

IN FIRST YEAR OF OPERATION, NEW POWER PLANT EVEN BETTERS FRED'S ESTIMATE!

Fred Koenig calculated a saving of $40,000. When the figures were in—after the first full year of operation—the saving actually amounted to $44,730!



Here's the coal-fired installation that engineer Koenig recommended, after carefully considering gas and oil as fuels. Specifically designed to get the most energy from today's coals, it saved the Wagner Co. $22,730 on fuel alone in the first year!



This large-capacity silo feeds coal automatically to the Wagner Company's power plant. It cuts handling costs—permits bulk buying of coal at lower rates—assures the Wagner Company of a steady, dependable source of power!

Today, bituminous coal, when used with modern equipment, is the most economical fuel for industrial use. Coal is now more efficient because it's *prepared . . .* washed and cleaned of all impurities. Modern, coal-fired equipment adds from 10% to 40% to the power obtained from the same amount of coal in years gone by.

And automatic controls, together with modern coal- and ash- handling apparatus, have dramatically reduced labor costs, done away with inconveniences—*making bituminous coal the best industrial fuel by far!*

America's coal mines are so productive that there will be no shortages to plague the companies that use coal as the source of their power . . . America's ample supply of coal is the best possible assurance that the price of coal will remain more stable than those of other fuels. Coal is always the safest fuel when it comes to both storage and use, factors of more than usual importance in these unsettled times.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

YOU CAN COUNT ON COAL!

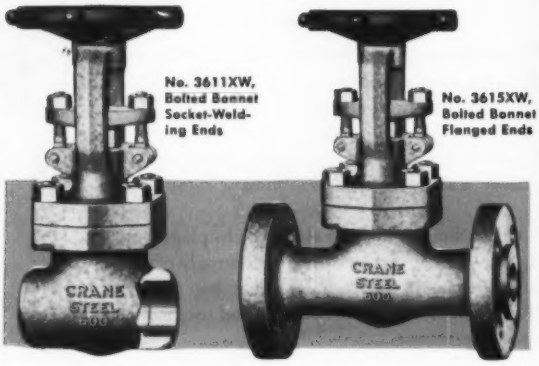
why CRANE 600-pound small steel gates are sure to meet your needs

You can't top these Crane Small Steel Gates for dependable performance on high pressure, high temperature lines . . . for ease of operation . . . for simplified maintenance. That's because they include design features normally found only in larger or more expensive valves.

Then too, these Crane valves are available in a choice of types to meet your particular requirements. For example, with union or bolted bonnets; with screwed, flanged, or socket-welding ends; and in trim materials recommended for all common fluids.

GET NEW DESCRIPTIVE CIRCULAR AD-1881

For complete information—including prices—about these longer lasting, easier operating Crane Small Steel Gate Valves. Ask your Crane Representative for your copy, or write direct. No obligation.

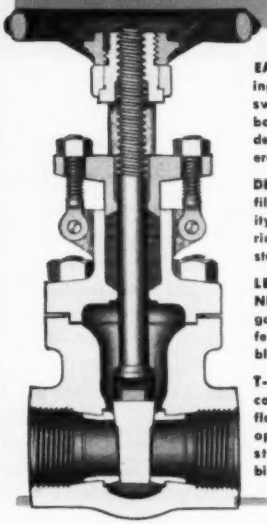


No. 3611XW, Bolted Bonnet Socket-Welding Ends

No. 3615XW, Bolted Bonnet Flanged Ends

UNION BONNET GATE. Screwed ends. Sizes: ¼ to 2-inch. Available in three different trim materials for a wide range of services. Also with socket welding ends

Easy to Operate... Easy to Service



EASY ACCESS to stuffing box assured by swinging gland eyebolts. Improved yoke design provides liberal working space.

DEEP STUFFING BOX filled with high quality asbestos packing rings maintains tight stem seal.

LEAKPROOF BONNET JOINT. Soft iron gasket in male and female joint cannot blow out.

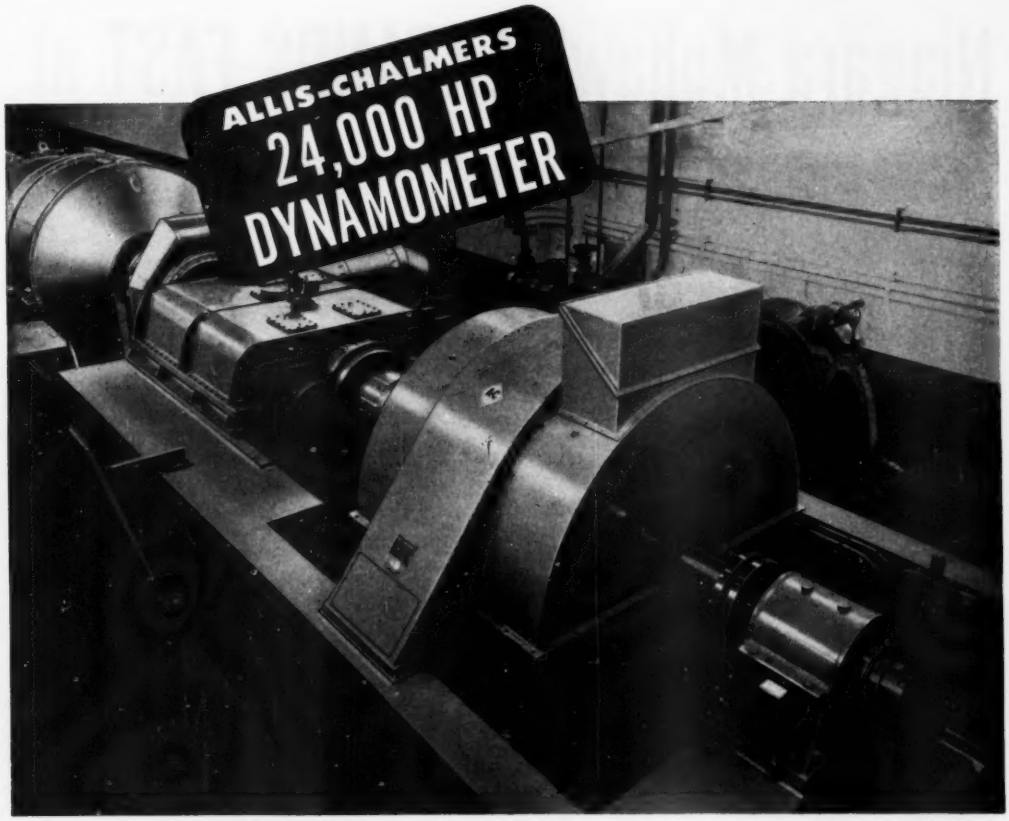
T-HEAD DISC-STEM connection provides flexibility for smooth operation; prevents stem distortion or binding of parts.

Cross-section No. 3607XW, Bolted Bonnet Gate, Screwed

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



Another Example of Allis-Chalmers Engineering

DESIGNING AND BUILDING this special power-delivering dynamometer required engineering skill available only to a company such as Allis-Chalmers with its century of engineering experience.

Arranged for direct measurement of torque, the dynamometer has an accuracy of ½% of the rated torque. Its overall speed range is 1210 to 15,072 rpm. And the 24,000 hp synchronous motor and its speed-increasing gear are supported by a special hydrostatically mounted base. Although the assembly weighs 130,000 pounds, it is so well balanced and cradled that it can be moved by the pressure of a man's finger.

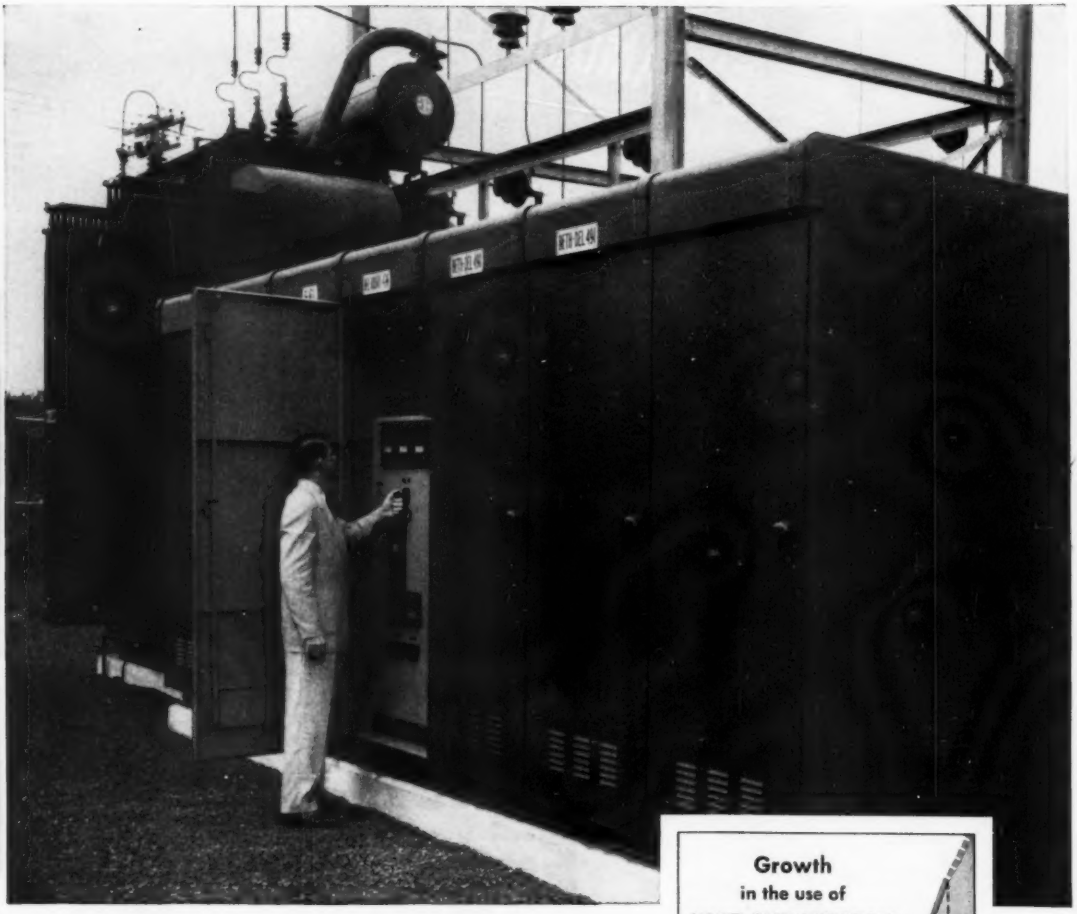
The dynamometer was built for the Pratt & Whitney Aircraft Division of United Aircraft Corporation for testing turbo-jet engines. Allis-Chalmers also supplied the torque measuring equipment, metal-enclosed bus duct and switchgear.

Whether you need special or standard equipment—for power generation, distribution or utilization — you can benefit from this engineering experience by calling your nearby A-C representative. Allis-Chalmers, Milwaukee 1, Wis.

A-3301

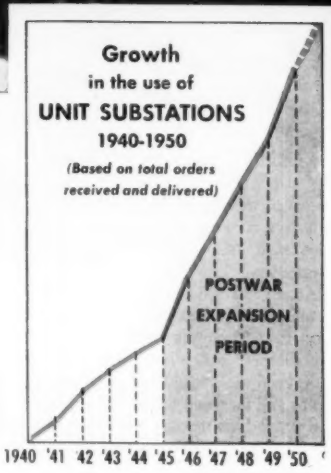
ALLIS-CHALMERS

Niagara Mohawk EXPANDS FAST at



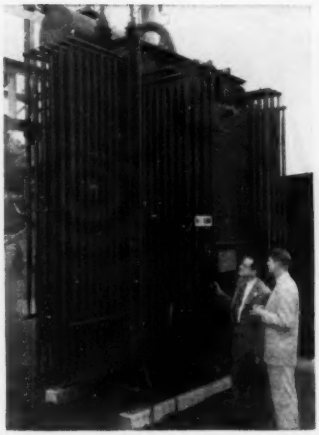
NIAGARA MOHAWK ADDS 10,000 quickly and easily with third and fourth G-E master unit substations (5000 kva each). The one above transforms 33 kv to 5.04 kv. Open compartment door shows operating panel for magne-blast breaker. More details in photos on opposite page.

WHAT DOES THIS TREND MEAN? Savings in time, money and materials are becoming more and more important. It also means that adaptable compact unit substations have proved to be perfectly suited in cases where "special designs" were thought necessary. You get plenty of flexibility when you use G-E packaged substations.

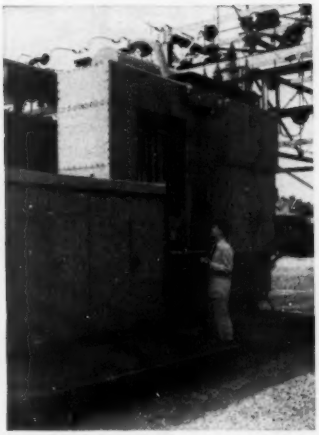


low cost—with G-E Unit Substations

CIRCUIT BREAKERS are safely and easily removed for inspection. This view shows rear of Niagara Mohawk's new G-E metal-clad transformer main breaker in operating position. Breaker cannot be lowered for removal until it is tripped and power circuit interrupted.



YEARS OF MAINTENANCE-FREE SERVICE ahead for transformers in Niagara Mohawk's new unit substation. Bus regulation of voltage is provided by load-ratio-control equipment. Experience shows G-E LRC equipment requires very little maintenance.



FORESIGHT PAYS OFF again and again. Above is section of older G-E master unit substation installed by Niagara Mohawk in 1939. Growing loads posed no problem—new unit (barely visible, upper left) installed alongside, capacity increased by 5000 kva.

Quick, easy ordering and installation help Niagara Mohawk expand fast to meet increased demand in Albany area

Like many other utilities and industrial plants, Niagara Mohawk Power Corp. has shown it pays to use "packaged" power equipment. In this locality, they've chosen a standard distribution system (in this case: primary network) and a standard load increment, or "building block" of power (5000-kva). As load grows, a duplicate substation of this capacity is tied into the system, always a jump ahead of demand.

A G-E unit substation arrives ready for use—you simply spot in place, connect, and energize. You save not only on equipment and installation costs, but also valuable engineering time to use for over-all planning.

These are just a few reasons for the fast-growing trend to unit substations shown in the chart on the opposite page. Your local G-E representative can show you plenty of others. Call or write him. *General Electric Company, Schenectady 5, N. Y.*

EXTRA $5000 SAVED BECAUSE OF FLEXIBILITY

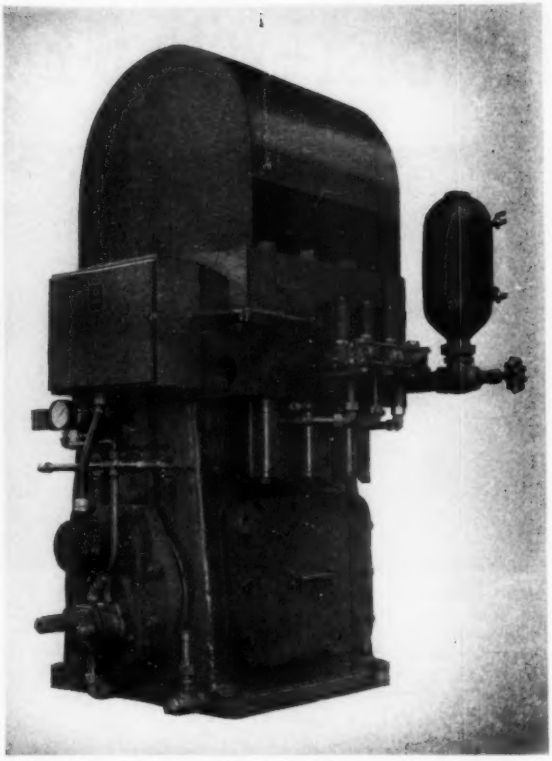
IDEA TO SAVE MONEY: Photo above is close-up of G-E metal-clad auxiliary compartment, installed with rest of Unit Substation. Flexibility permitted Niagara Mohawk to install 48-volt battery, charger, telephone. By doing this instead of using special construction, Niagara Mohawk estimates they saved $5000 to $8000.

321-80

GENERAL ELECTRIC

PLAY SAFE–

Power Your Hydraulic Equipment with Water... and WORTHINGTON



Worthington VTE pump equipped with unloader, used in hydraulic systems for generating pressures.

Current practice in the engineering of hydraulically-operated machinery shows a trend toward *water* . . . in order to eliminate the fire and toxic hazard.

Where oil is used, there is always the possibility of explosion and fire due to leaking oil encountering hot metal.

And the pump that's best—most efficient, most economical—for furnishing a central system with water under high pressure is Worthington's high-speed VTE (vertical triplex enclosed).

This constant speed power pump is equipped, for this purpose, with Worthington's suction valve unloader. It is the only high-speed vertical pump on the market with such a device.

Automatic Control for Intermittent Operation

This device, built around an electric synchronizing distributor, unloads each cylinder in sequence, providing quick but gradual decelerating of fluid delivery, from full to zero flow, in not more than one revolution of the pump.

This control is accomplished efficiently on the low-pressure side with no shocks in unloading or loading. It permits operating the pump at speeds of 400-500 rpm.

Complete Line— of Pumps, of Auxiliaries

Worthington makes a complete line of pumps—and auxiliaries too—for all hydraulic power services, including horizontal and vertical power pumps, centrifugal, steam, and rotary pumps. Only Worthington gives you such a range of choice. Manufacturing *all* types of pumps, Worthington can give you the one best type for *your* application.

For further description of Worthington equipment for hydraulic systems, information proving *there's more worth in Worthington*, write to Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, New Jersey.

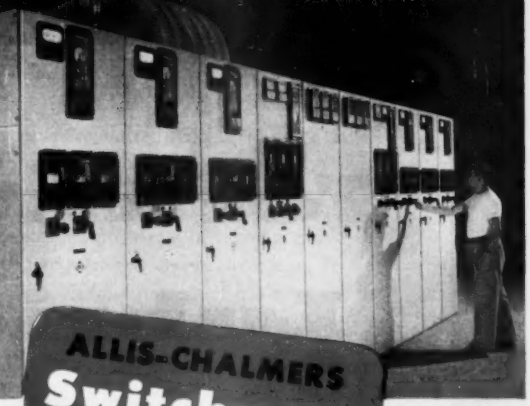
WORTHINGTON

P.1.5

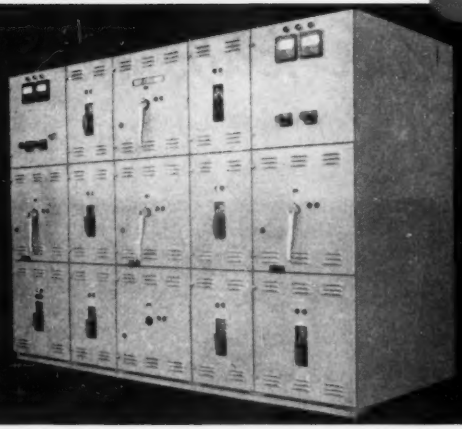
THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

HIGH-VOLTAGE SWITCHGEAR FEATURES

- New—less floor space but more room for instruments, relays, transformers, buses, etc.
- Welded-in floor plates simplify foundation requirements, provide easy breaker handling.
- Wide guide rails in breaker compartments add rigidity and protect wiring.
- Looped wiring minimizes wear at points where flexing occurs.
- Horizontal contact separation of *Ruptair* circuit breakers adds thermal assist to magnetic arc interruption.



ALLIS-CHALMERS Switchgear



LOW-VOLTAGE SWITCHGEAR FEATURES

- Safe dead-front, compartmentalized construction, with entire structure grounded.
- Rigid construction of framework assured by jig-welding and lap joints.
- Breakers of same rating are interchangeable. Pantograph mounting makes circuit breaker withdrawal easy.
- Circuit breakers can be tested within switchgear unit for added convenience.
- Individual, enclosed, wall-mounted breakers available for locations where needed.

Here's *Insurance* for CONTINUOUS PRODUCTION

YOUR accountants can tell you exactly how much your plant and equipment is worth. But productive use of that investment is becoming increasingly dependent on electrical power, and modern switchgear is essential to the efficient, continuous distribution of that power within your plant.

Allis-Chalmers switchgear can help you maintain full production . . . on schedule. Since this equipment is standardized, new units can readily be incorporated if your requirements change during the years ahead. Servicing is cut to a minimum and is quick, easy and safe because design features and engineering details are dictated by operating and maintenance experience.

Some of the features are listed above. More details are given in Bulletin 18B6185. Why not ask your A-C representative for a copy, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3523

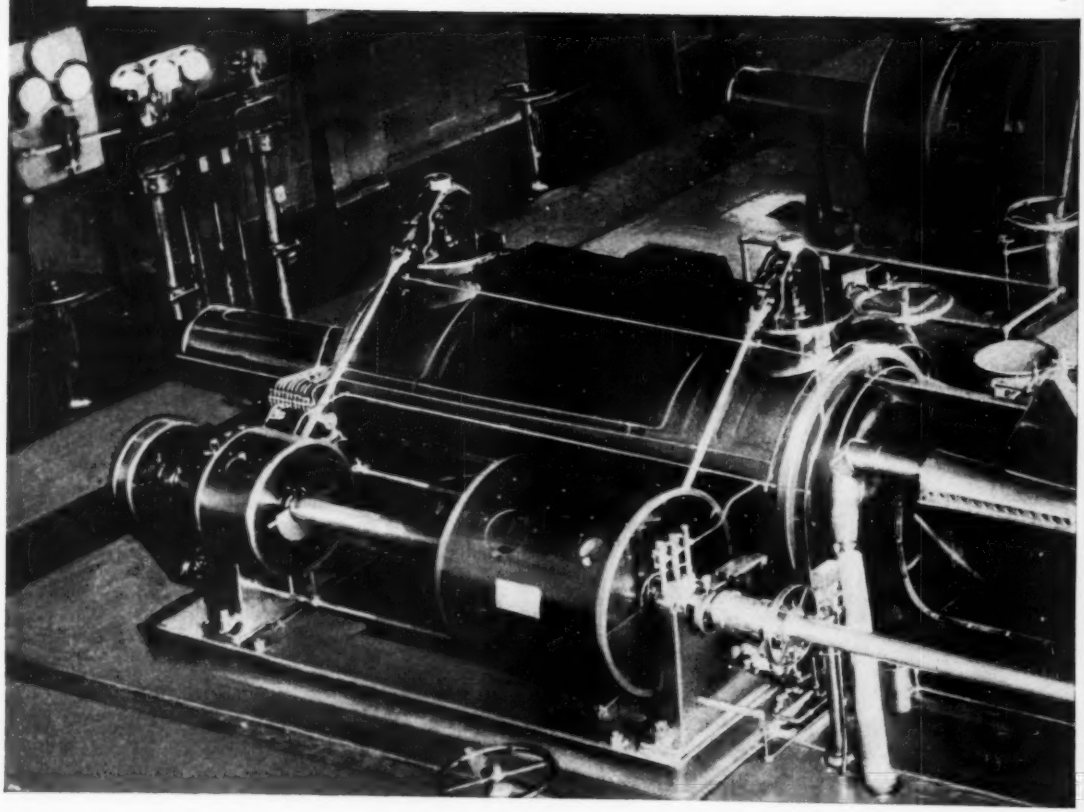
Ruptair is an Allis-Chalmers trademark.

ALLIS-CHALMERS

FIRST IN THE U. S. WITH METAL-CLAD SWITCHGEAR

For Extra Fine Lubrication..

use Sinclair Rubilene



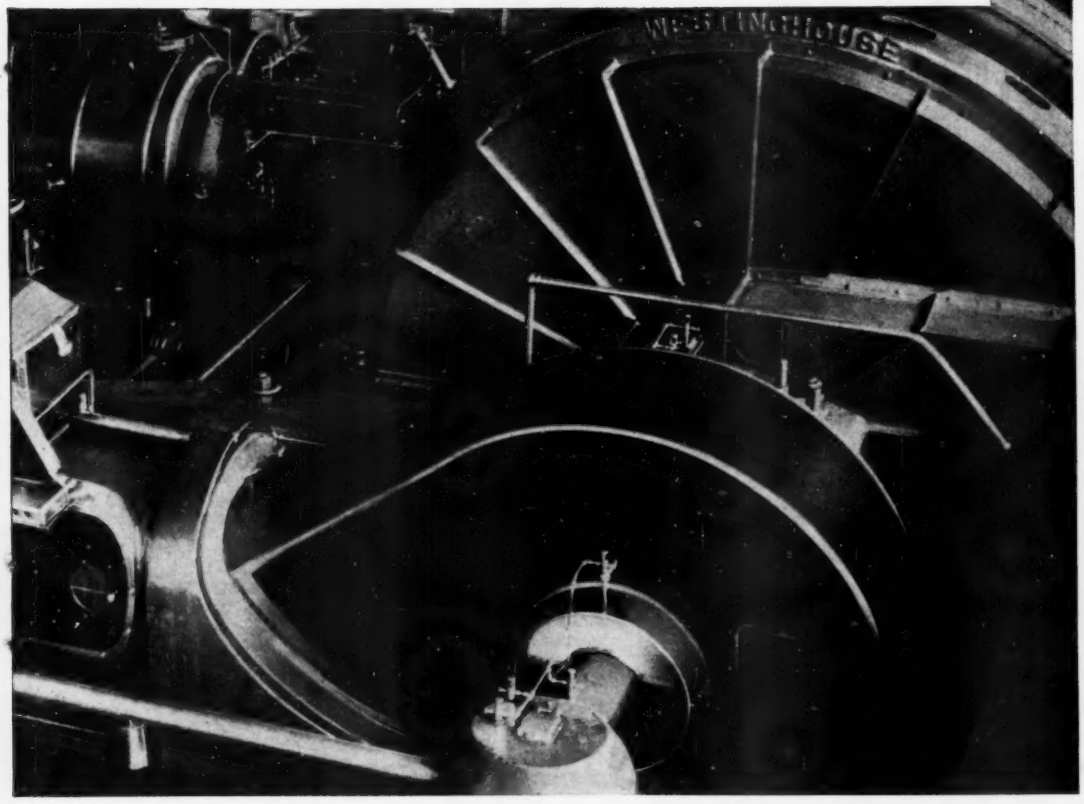
Over many years engineers and plant operators have recognized Sinclair RUBILENE® as capable of rendering extra fine lubrication performance in the powerhouse.

Sinclair RUBILENE has always been a top-quality oil, as it has been constantly improved through the years, incorporating the latest technological developments in refining and processing. It resists oxidation under continuous high temperatures, and re-circulation. It separates rapidly from water, and is non-foaming. Through long periods of use it retains its original qualities, providing uniform, trouble-free lubrication and low maintenance costs.

Yes... RUBILENE's finer quality pays dividends. For lubrication counsel, see your nearest Sinclair Representative or write direct to Sinclair Refining Co., 600 Fifth Ave., N.Y. 20, N.Y.

SINCLAIR RUBILENE®

for low maintenance costs



FISHER®

Offers You The and Complete Line

TYPE 57T

Diaphragm motor valve equipped with Fisher Positrol-valve positioner.

Features:

1. **Large superstructure for power to overcome friction losses.**
2. **Fisher Teflon V-Ring Packing requires no lubrication.**
3. **Wall sections and boltings conform with ASA code.**
4. **Yoke mounting boss for valve positioner.**
5. **Quality controlled materials and workmanship.**

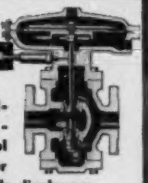
TYPE 530

High rangeability diaphragm control valve for small flows and high pressure drops commonly encountered in experimental and pilot plant operations.

TYPE 567

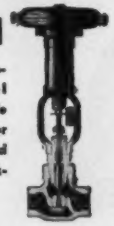
Reverse action topwork, generally used with push-down-to-close valves which must be spring closed in action.

TYPE 790R



Pressure balanced diaphragm control valve — either single or double diaphragm construction — for use with remote mounted instrument or pressure loader.

TYPE 57T-D



High pressure diaphragm control valve. Available in small sizes for 3,000 lbs. and 6,000 lbs. working pressure.

FISHER TEFLON V-RING PACKING

- No gland leakage.
- Used on wide range of pressures without appreciable change in friction values.
- Elimination of maintenance and adjustment.
- No valve stem lubricators required.
- Chemically inert to all fluids up to 450° F.

FISHER LEADS THE INDUSTRY

Industry's Most Versatile of Diaphragm Motor Valves

Illustrated here are just a few of the complete line of Fisher Governor Company diaphragm motor valves. They are manufactured to handle pressure conditions up to 10,000 pounds, for high pressure drops, for handling contaminated fluids (coke, sludge, slurry). Available in metals for highly corrosive service and alloys for high temperature work. They are built for your specific requirements with a wide choice of inner valves to provide desired flow characteristics.

TYPE 57T-DA

High pressure diaphragm control valve. Available in small sizes for 3,000 lbs. and 6,000 lbs. working pressures with angle body.

TYPE 5700

Springless type diaphragm motor valve, double diaphragm actuated. Power actuator suitable for up to 5,000 lbs. unbalanced thrust.

TYPE 1657S

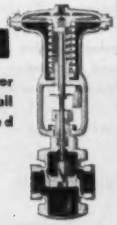
Three-way diaphragm motor valve with single disc, double seat, commonly used on flow diversion work.

TYPE 57T-K

Diaphragm motor valve with fully balanced inner valve with soft seat for tight closure.

TYPE 510S

Diaphragm motor valve with small single seated bronze body.



TYPE 461-462

Diaphragm motor valve with Sweep-Flo angle body and continuous connected handwheel diaphragm motor operator

TYPE 7700

Diaphragm motor valve with butterfly valve construction for handling large volumes under low pressure drop conditions.

TYPE 581

Diaphragm motor valve, single seated, piston balanced with internal pilot.

TYPE 57T-L

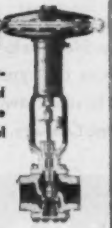
Single seated, flapper check for low pressure drop installations such as motor runs.

TYPE 1657T

Three-way valve, double port, double disc, full throttling.

TYPE 57Q

Diaphragm operated single seated body, reversible without additional parts.



TYPE 57T

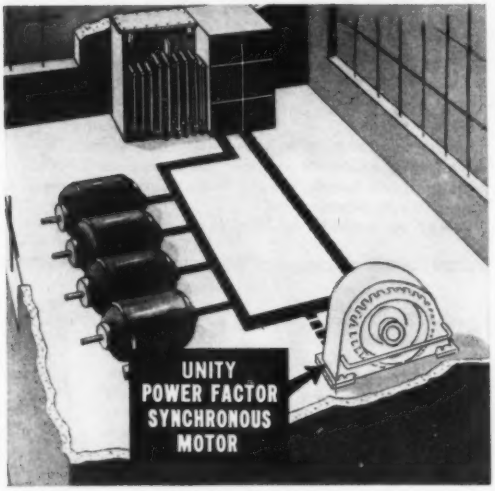
Standard diaphragm motor valve, available with variety of inner valve constructions.

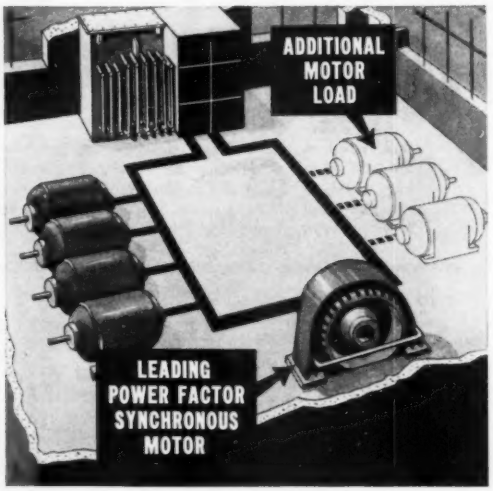
FISHER GOVERNOR COMPANY, Marshalltown, Iowa

IN RESEARCH FOR BETTER PRESSURE CONTROL

How to get more out

. . . . *install G-E Synchronous Motors*





If your plant power system is loaded close to full capacity and you have a place where a large constant-speed motor can be used, you may be able to install a *unity power-factor* synchronous motor without increasing the kva load on your system.

Or, if your power system is already overloaded, then a *leading power-factor* synchronous motor can actually supply kvars to your system while performing its usual drive duties. Then you can often install additional inductive apparatus to an existing system without fear of overloading feeder lines.

If you are planning plant expansion or you need more motors and/or suspect power system overloading, contact the nearest G-E sales engineer. He'll help you survey your system, and help you determine the type of synchronous motor you need—should this be one answer to your power system problems. *General Electric Company, Schenectady, N.Y.*

NEW! A Helpful Training Course on Motors!

Everyone concerned with technical training problems will want this new G-E Motor Selection and Application Course. Consists of 9 short, easily understood lessons. Complete kit—slide films, review booklets and instructor's manual—$100. Call or write your nearest G-E sales office, or send for free copy of 96-page instructor's manual.

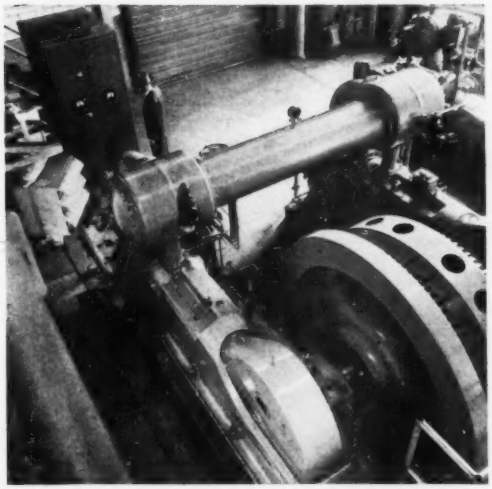
Look at the scope of this Course

1. Fundamentals of Motors
2. Types of Motors
3. Fundamentals of Selection
4. A-c Induction Motors
5. Single-phase Motors
6. D-c Motors
7. Synchronous Motors
8. Adjustable-speed Drives
9. Gear Motors

GENERAL ELECTRIC

# of your power system

for unity and leading power-factor drives

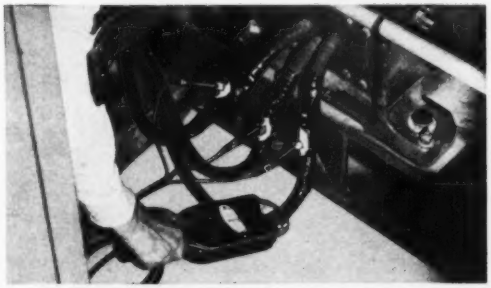


Control, too, will protect your system—G-E Limitamp high-voltage control provides ample interrupting capacity, protection for operating personnel, good appearance, and compactness. Here it controls and protects a 350-hp G-E synchronous motor.

G-E SYNCHRONOUS MOTORS ARE DRIVING . . . .

pumps
compressors
Jordans
beaters
crushers
ball mills
tube mills
large conveyors
blowers
saws
generators
rolling mills
pulp refiners
chippers
flour mills
stock refiners
line shafts
fans . . . .

in all types of industries where their efficiency, low first cost, and reliability make them exceedingly popular.



Check power factor on individual circuits—easily, quickly—with new G-E hook-on power-factor meter. This portable instrument hooks around the line—no cutting of conductors, no costly shutdowns to make power checks. You can accurately locate those circuits where corrective action is needed.

mail this coupon today

General Electric Co. Sect. Y 770-25
Schenectady 5, N. Y.

Please send me the following literature. . .

☐ for reference purposes
☐ for planning an immediate project

( ) GER-234—Synchronous Motors Do Two Jobs at One Time
( ) GEA-5332—Low-speed Synchronous Motors
( ) GEA-5426—High-speed Synchronous Motors
( ) GEA-5469—G-E Testing Instruments
( ) GEZ-310—Motor Training Course Instructor's Manual

Name .....

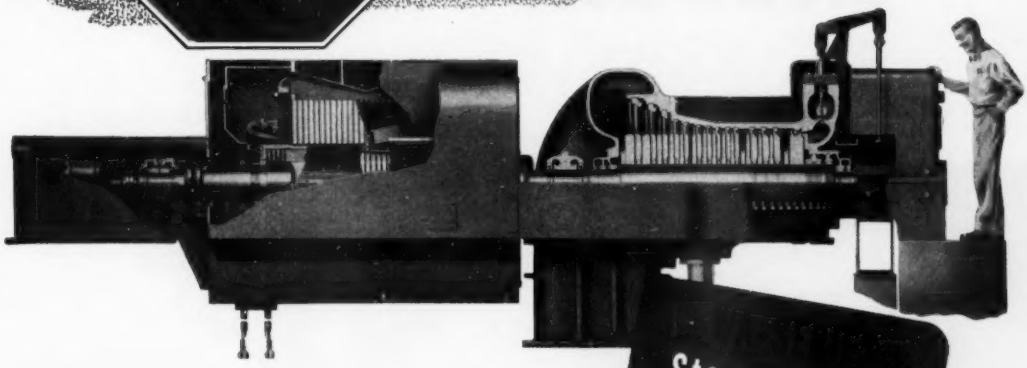
Company .....

Address .....

City ..... State .....

NAVCO
PROVIDES THE
POWER ARTERIES
IN THIS
CENTRAL STATION
Just another modern High Pressure-High Temperature Power Plant in the Southwest that has DEPENDABLE Piping.
NAVCO
NAVCO PIPING
NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.
NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

END ..Generation Worries!



INSTALL MODERN EQUIPMENT

COMING DAYS of higher process steam and power demand will make power plant outages doubly hard to bear. Where will *you* be in this picture? Prepared with modern equipment to carry this severe load? Or just hoping for the best with outworn and outmoded equipment.

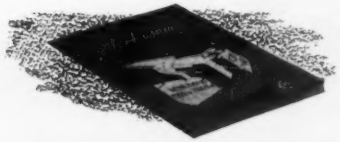
Truly modern WA-Series steam turbine generating units are already generating power and can be working for you sooner than you think. They are supplied in a wide range of NEMA ratings through 7500 kw, for either condensing or non-condensing service, with or without automatic extraction.

The accurate, reliable centrifugal type speed governor is the same kind used by Allis-Chalmers on its large steam and hydraulic turbines. The governing system incorporates oil pressure and if turbine system oil pressure should drop for any reason, the main throttle and inlet valves will close immediately, safeguarding the unit.

And just as in the larger Allis-Chalmers steam turbines ranging to 150,000 kw, trouble-free labyrinth steam seals are used for glands and interstage packing. Gland casings, moreover, are removable without disturbing the turbine casing.

These modern generating units are functionally attractive and completely coordinated in design. Impulse turbine, housing type air-cooled generator, and exciter are designed, manufactured, assembled, and tested under one supervision at one plant.

Get the *full* story on the quality features in the modern WA-Series! Be sure *your* next generating unit is up to date. Call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3530



BULLETIN NOW AVAILABLE!
Ask for WA-Series Bulletin 03B7654

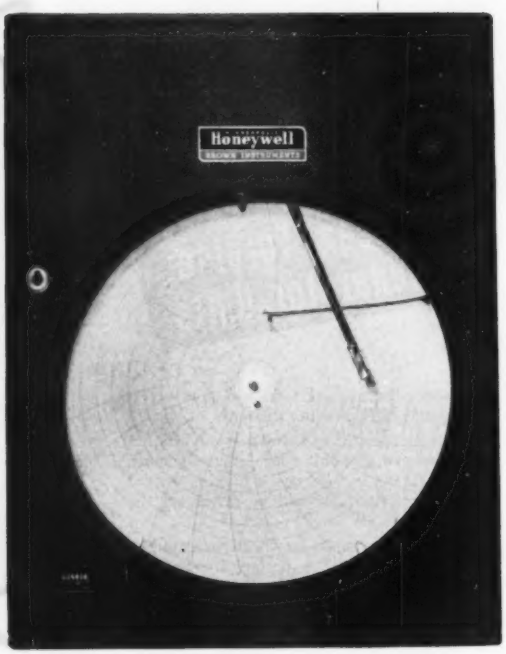
ALLIS-CHALMERS

TURBINES & GENERATORS | CONDENSERS & PUMPS | SWITCHGEAR & BREAKERS | MOTORS & CONTROL | TRANSFORMERS | WATER CONDITIONING

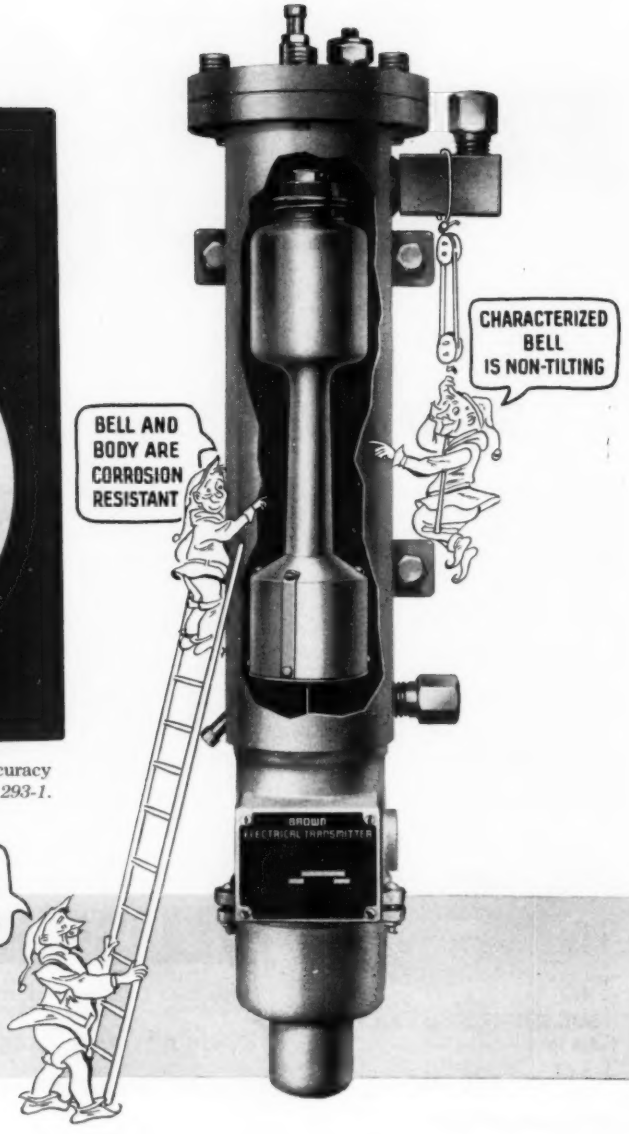
World's Widest Range of Power Plant Equipment

Important Contribution to

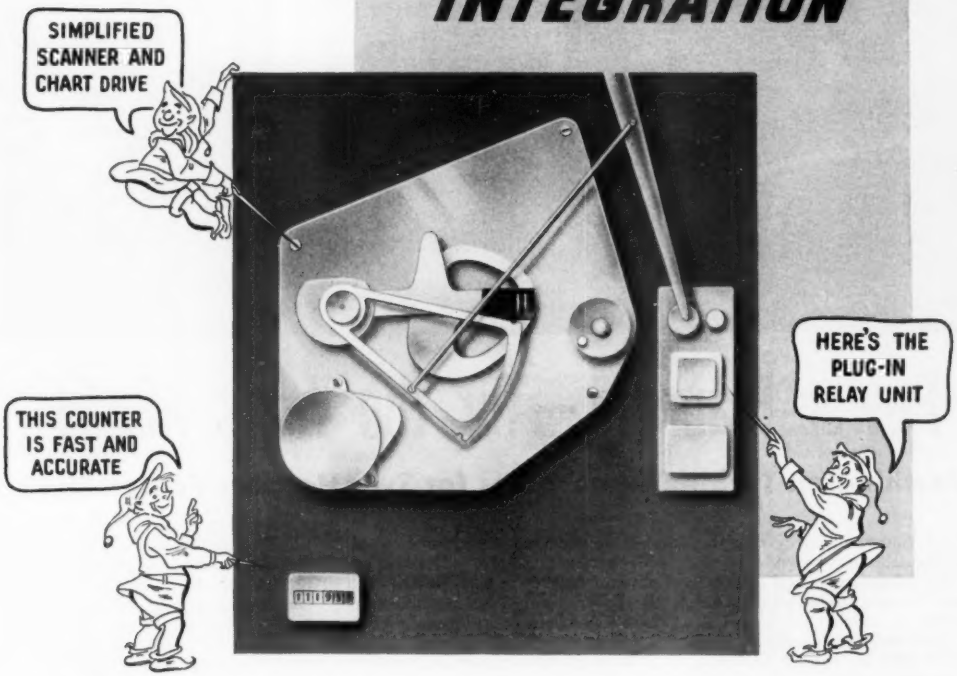
The New Brown Electric Flow Meter



EVENLY-DIVIDED CHART . . . provides uniform accuracy for all rates of flow. Write for new *Bulletin No. 293-1.*



incorporates . . . ELECTRONIC INTEGRATION



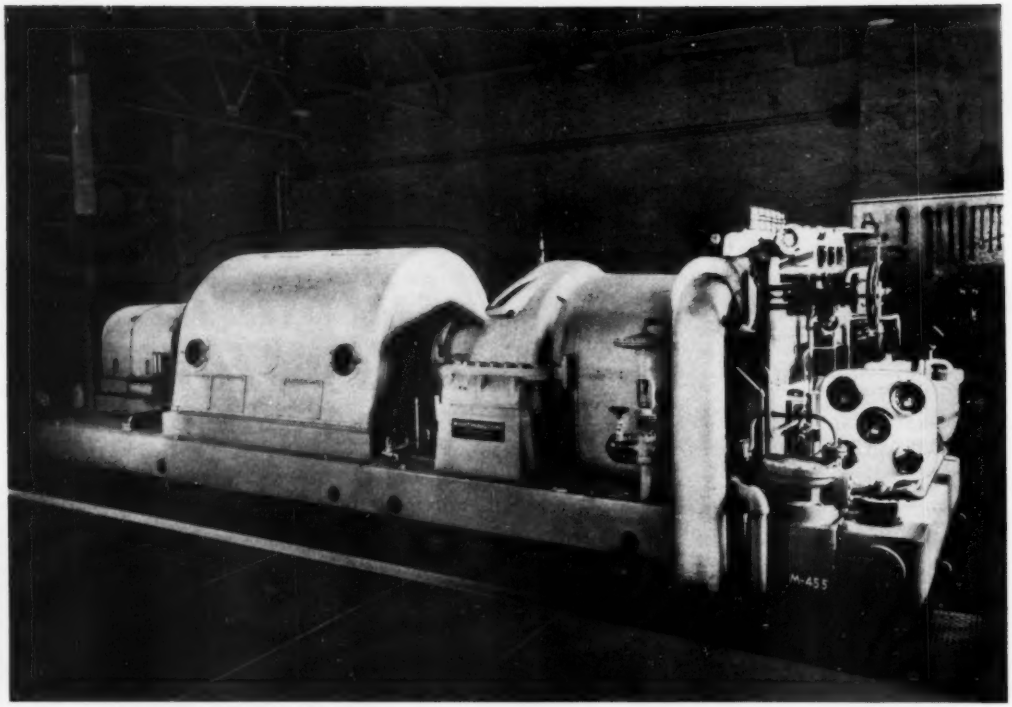
HERE's another important advancement for power and process instrumentation . . . continuous flow measurement, with electronic integration! This Honeywell development eliminates intermittent measurement and slow, complicated totalizing . . . welcome news to process engineers and accountants.

The electronic integrator, consisting of but three major parts, simplifies accessibility and maintenance . . . permits quick checking and calibration. Scanning is rapid and extremely simple. The corrosion resistant meter body is of tubular construction, reducing weight and bulk. Transmission is electric, recorder is fast, chart is easily read under all conditions of flow. The characterized bell is corrosion resistant, too, and is specially designed to eliminate tilting.

Call in our local engineering representative for a discussion of your application.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
Brown Instruments



Power Planning—for the Years Ahead

Worthington Turbine Generators for Two Harbors Power Plant

This is how the City of Two Harbors, Minnesota met expanding power and light requirements and found the answer to economical power plant operation.

In 1948 the city installed a Worthington 2500-kw turbine generator. This machine operates in parallel with other units already installed in the power plant.

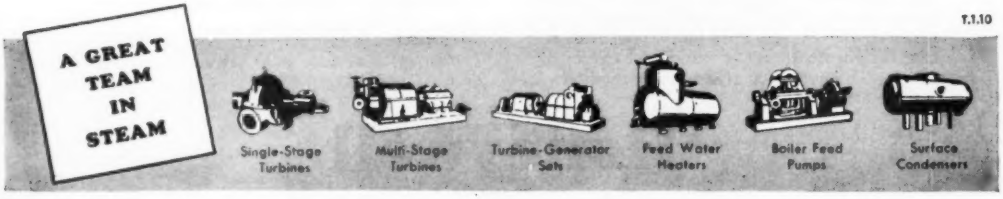
As the electrical demand grew, a survey showed that another power-producing unit was needed. Again, a Worthington turbine generator was selected. The new 3500-kw Worthington unit, to be installed next year, will supplement the existing power plant equipment. With this latest addition, the City of Two Harbors will be fully equipped to handle all its power and light needs for many years to come.

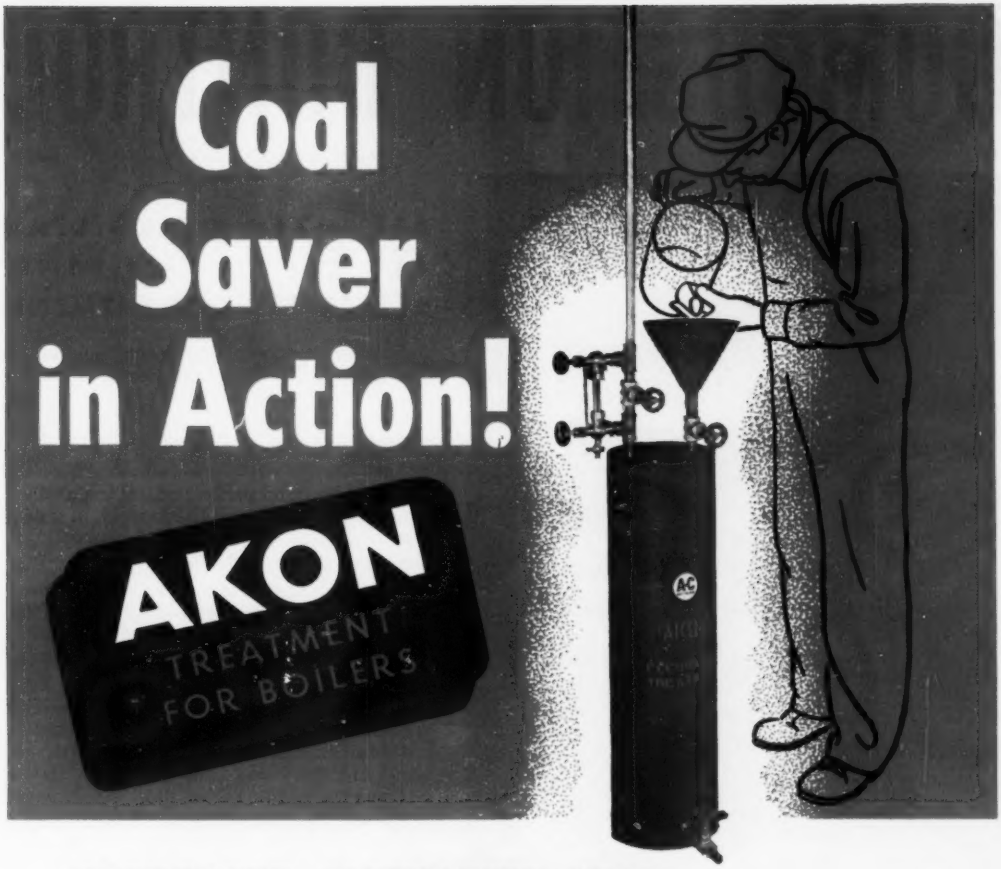
Worthington builds steam turbines in all types and sizes—and turbine-generator sets up to 10,000 kw. For proof *there's more worth in Worthington*, call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.

WORTHINGTON

STEAM TURBINE GENERATORS

T.1.10





DECREASED BLOWDOWN CUTS FUEL COST FOR BOILERS

BOILER BLOWDOWN wastes many tons of your coal every month.

The primary job of *Akon* treatment is to keep that waste at a minimum. *Akon* treatment takes sludge particles out of circulation harmlessly, forming *non-adherent* flocs which can be removed by less blowdown than would otherwise be required. In turn, less blowdown means savings in coal, water and chemicals . . . and no sludge deposits remain.

Akon treatment is also an excellent oxygen absorbent; it effectively scavenges traces of oxygen not removed by deaerators. Thus, both corrosion and the ills due to sludge are corrected by this one treatment.

Give your boilers the treatment they deserve. For sludge control and oxygen scavenging, use *Akon* treatment for boilers.

Akon is an Allis-Chalmers trademark.

ALLIS-CHALMERS

Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE

SEND FOR the two Allis-Chalmers bulletins, BLOWDOWN (No. 28X7731) and *AKON* (No. 28B7408). In these concisely written bulletins you will find material helpful in training personnel for your power plant and valuable information on blowdown problems.

Allis-Chalmers
Milwaukee 1, Wisconsin

Gentlemen:

Please send me bulletin number
☐ 28X7731 on Blowdown
☐ 28B7408 on Akon treatment

Name

Title

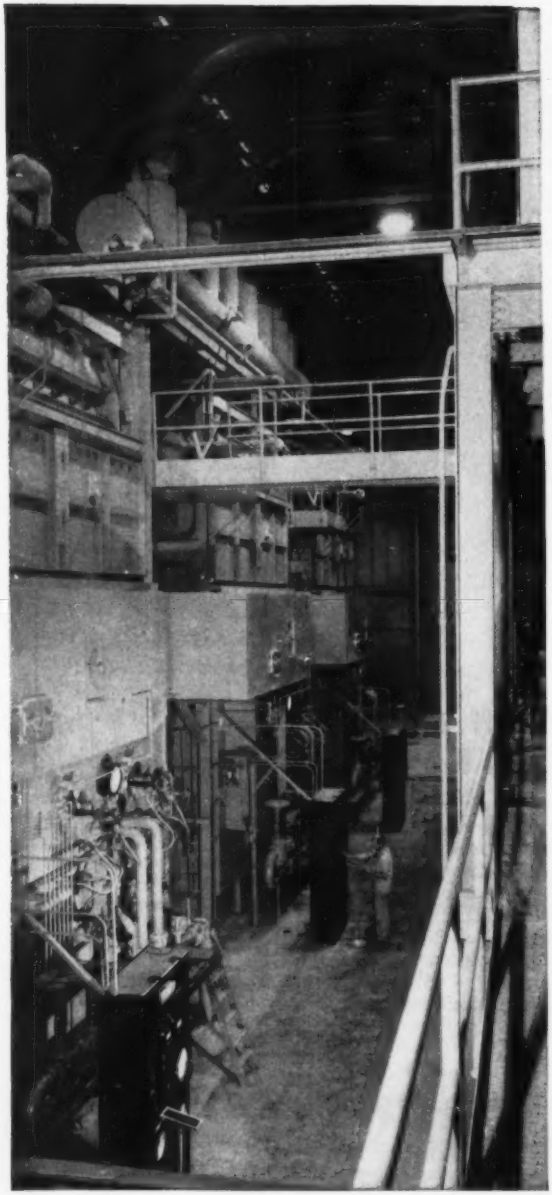
Company

Address

City State

A-3539

COMBUSTION CONTROL



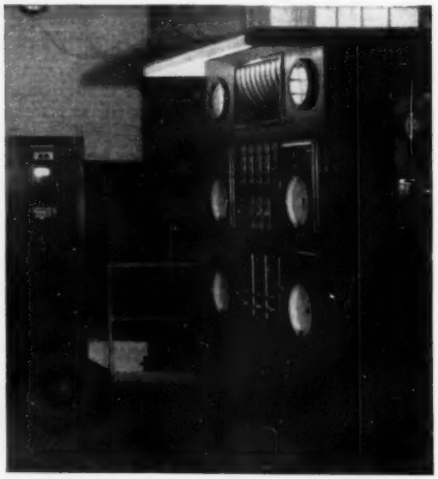
FOR
ALL SIZES OF BOILERS
ALL TYPES OF FIRING
ALL LOAD CONDITIONS

An automatic combustion control system, as designed and built by Republic, will enable you to operate your boiler (or boilers) over a long period at test efficiencies regardless of variations in fuel, load and other operating factors.

Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler.

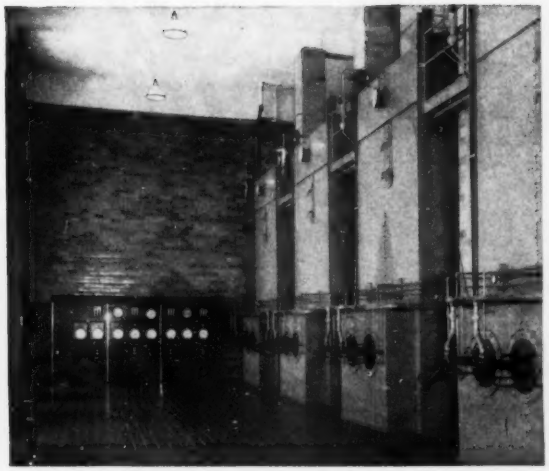
It automatically increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

Republic automatic combustion control systems, either pneumatic or hydraulic, are available for all sizes of boilers, all types of fuel firing, and load conditions and any arrangement of draft equipment. They are completely described in Data Book No. S-21—write for your copy.

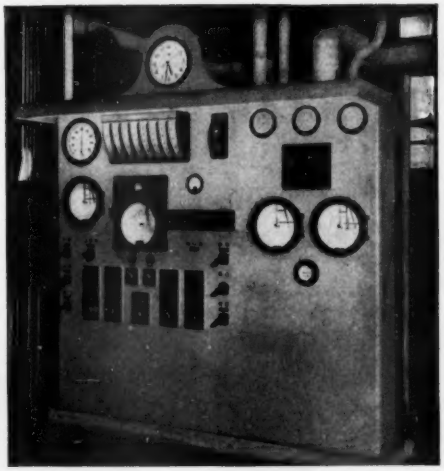


GAS FIRED—In this modern industrial plant steam is generated at the rate of 400,000 lbs. per hr. by four gas fired boilers operated by a Republic automatic combustion control system.

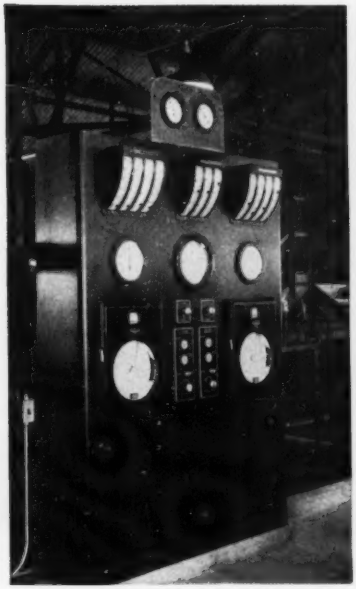
STOKER FIRED—The Republic instrument and combustion control panel for an 80,000 lbs. per hr., stoker fired boiler in a municipal power plant.



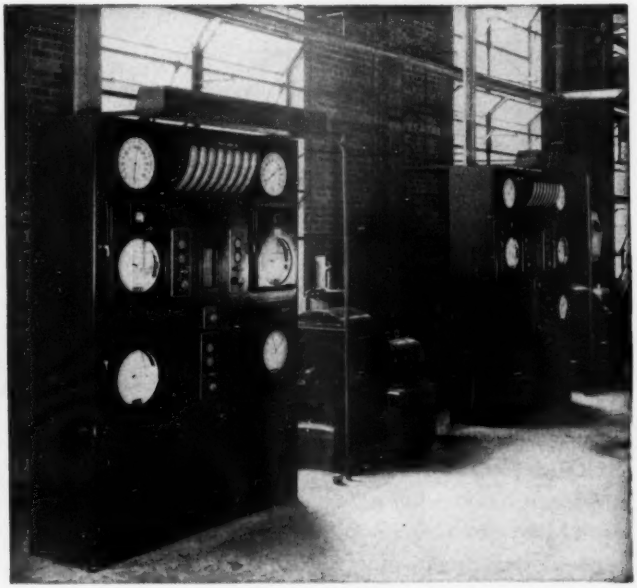
OIL AND GAS FIRED—In this model boiler room of a large institution the four combination oil and gas fired boilers are operated by a Republic automatic combustion control system.



STOKER FIRED—The Republic combustion control and instrument panel for the automatic operation of a 45,000 lbs. per hr. stoker fired boiler.



MIXED GAS—Republic instrument and control panel installed in a natural gasoline plant to automatically control two 50,000 lbs. per hr. boilers burning mixed gas.

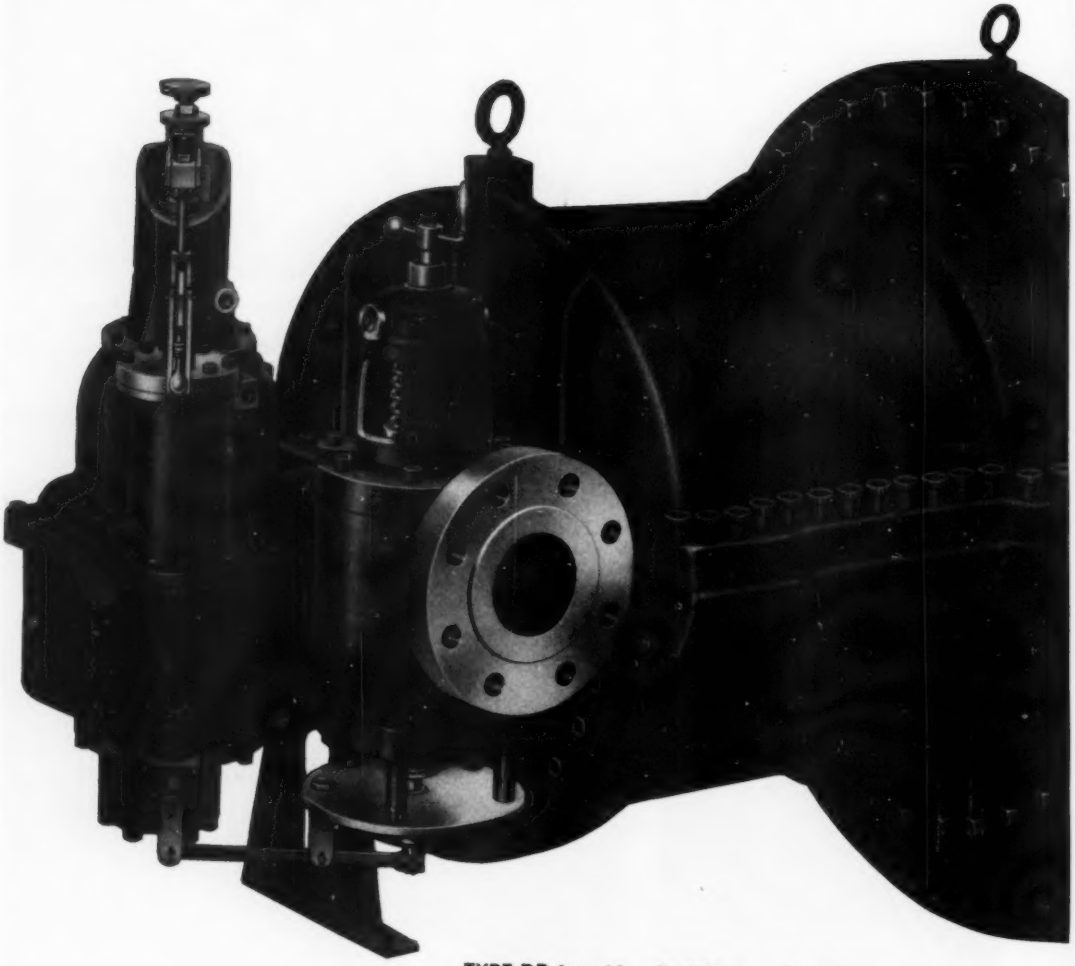


STOKER FIRED—A typical Republic combustion control installation in the boiler room of a mid-western university for the automatic operation of two 25,000 lbs. per hr. stoker fired boilers. All boiler instruments and manual controls are centralized on the two panels pictured above.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

GENERAL ELECTRIC ANNOUNCES *New*



TYPE DR for wide adjustable-speed range

Multi-Stage Turbines

Available in Four Designs—200 to 5000 hp

Now in production! General Electric's completely new, multi-stage turbine drives . . . designed to give you maximum mechanical power for every fuel dollar . . . available to meet any mechanical drive application where efficiency and reliability are "musts."

FOUR NEW TYPES—The DP, DR, DRV, DRVX—incorporate the newest ideas in improved turbine design. Four different governing systems give you a wide selection of performance ratings for either condensing, noncondensing or automatic extraction applications.

NEW FEATURES that spell increased economy and reliability are built into General Electric's new multi-stage turbines. A completely new sectional valve gear, for instance, gives you greater efficiency for part load operation. Refinements in governing, lubrication and steam chest design make these the finest mechanical-drive turbines General Electric has ever produced.

A NEW TECHNIQUE of manufacturing from standard, interchangeable patterns promises you savings in initial investment and shortened delivery time. You get a custom turbine, designed for your job, built from standard parts.

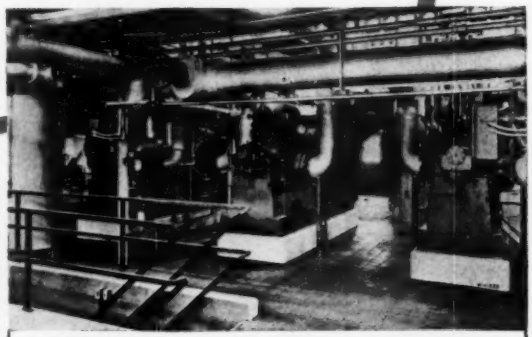
Get the full particulars on these brand new multi-stage turbine drives. Write for your copy of our new bulletin, GEA-5580, "G-E Multi-Stage Turbine Drives." Section 252-52, General Electric, Schenectady 5, N.Y.

252-52

GENERAL ELECTRIC

What Metals Are Best For Centrifugal Boiler Feed Pumps?

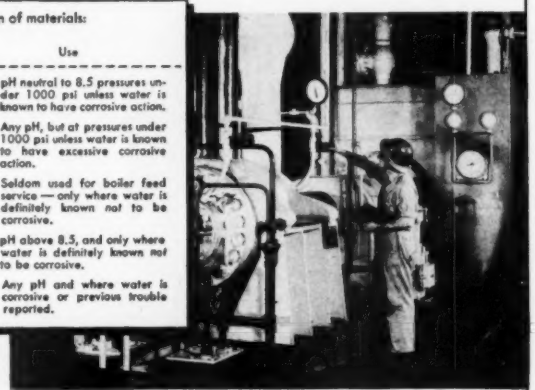
Drawing on their long experience in the field of hydraulics, Worthington engineers produce boiler feed pumps that are metallurgically correct in design, meeting every requirement as to temperature, pressure and corrosion-erosion resistance. As a result, Worthington boiler feed pumps perform better and last longer.



Three Worthington Axially Split Centrifugal Boiler Feed Pumps At The Kansas Power And Light Company Plant, Hutchinson, Kansas.

The following table represents Worthington's recommendation of materials:

Casing	Fittings	Maximum Temperature	Use
1. Cast Iron	Bronze	250 F	pH neutral to 8.5 pressures under 1000 psi unless water is known to have corrosive action.
2. Cast Iron	13% Chromium Stainless Steel	350 F	Any pH, but at pressures under 1000 psi unless water is known to have excessive corrosive action.
3. Carbon Steel	Bronze	250 F	Seldom used for boiler feed service — only where water is definitely known *not* to be corrosive.
4. Carbon Steel	13% Chromium Stainless Steel	400 F	pH above 8.5, and only where water is definitely known *not* to be corrosive.
5. 5% or higher Chromium Steel	13% Chromium Stainless Steel	Any temperature normally encountered	Any pH and where water is corrosive or previous trouble reported.



One of Several Solid Barrel, Radially Split, High Pressure Boiler Feed Pumps at the Trenton Channel Station of the Detroit Edison Co.

This proven selection of materials coupled with the most advanced design, superior workmanship and a thorough knowledge of application show why . . .

THERE'S A *RIGHT* WORTHINGTON PUMP FOR YOU

. . . *right* for the pressure and temperature of your boiler feed service . . . *right* for maximum economy and dependability. For further proof that *there's more worth in Worthington*, contact our nearest District Office, or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

MEMBER

WORTHINGTON

C1.2

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Hotwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 650 Feet
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1600 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3500 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet

here's how

NEW COAL HANDLING SYSTEM REDUCES COST

James F. Bransfield Co. Cuts Equipment Investment, Speeds Work with Versatile Allis-Chalmers Tractor and Front-End Shovel

ON COAL

STOCKPILES — HD-5G Tractor with Tracto-Shovel pushes coal wherever desired on stockpile. Traveling anywhere, it is more flexible than conveyor or bridge systems — lower cost, too.

COMPACTS — With added weight of fully loaded bucket, HD-5G compacts coal for safety from fire. Tight packing of thinly spread horizontal layers eliminates flues that often cause spontaneous combustion in loose conical piles.

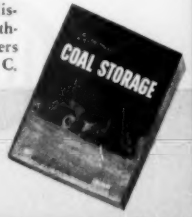
RECLAIMS — With 2-yd. bucket and 9-ft. dumping height, the HD-5G efficiently loads coal from stockpile to trucks for hauling to power plant. On short hauls it 'dozes or carries coal.

ON CINDERS

STOCKPILES cinders from power plant, placing piles wherever there is available space, without need for conveyors, tracks, etc. HD-5G works effectively either as 'dozer or loader in stockpiling.

LOADS THEM FAST — Owner supplies cinders to concrete contractors, finds handling them with the HD-5G faster and lower cost than the power shovel formerly used for this purpose.

● Send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors." Describes modern coal-handling methods, using A-C tractors and 'dozer blades, front-end loaders and scrapers. Write Allis-Chalmers Tractor Division, Dept. C.



Tracto-Shovels are available for all four sizes of A-C tractors. Standard buckets 1 to 4 yd., coal-handling buckets 2 to 7 yd.

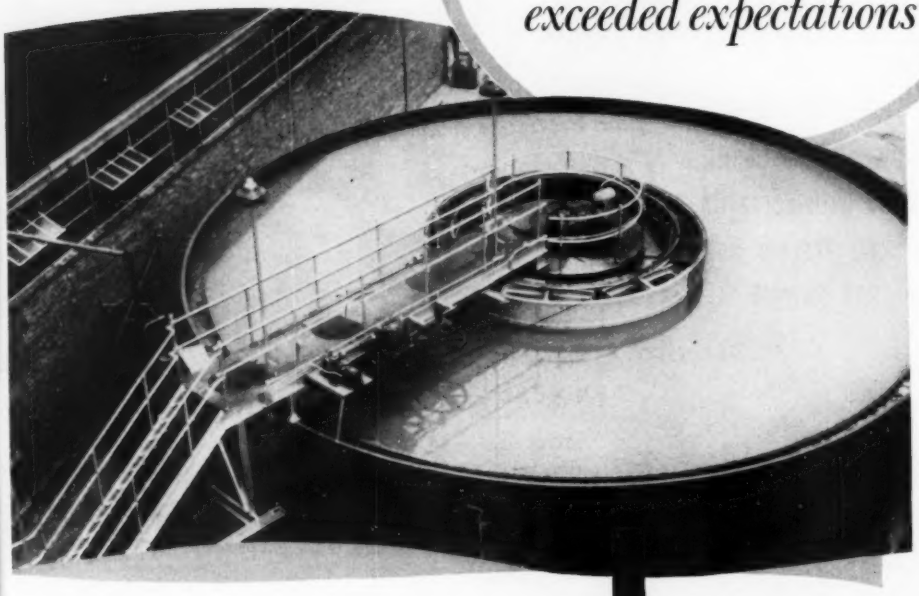
A-C tractors also provide additional return on your investment through use in plant or yard maintenance, car spotting, snow removal, dozens of other jobs.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

The Norristown Magnesia and Asbestos Company had a difficult problem in the treatment of its asbestos fiber wastes. It experimented with many methods. A Cyclator pilot plant proved that it could meet the problem . . . and the actual installation is surpassing pilot plant results!

Norristown Magnesia and Asbestos Company Cyclator. Gilbert Associates, Inc., Consulting Engineers

Where others failed... Cyclator® *exceeded expectations*



THE PROBLEM

Treatment of asbestos fiber wastes from mill board, insulation and wool felt products containing varying amounts of talc, carbon black and scrap material. Problem further complicated by shock loads occasioned by dumping of beaters without warning, which increased per cent of solids 2 to 3 times.

THE SOLUTION

Installation of a 45-foot diameter Cyclator and a Vortex Grit Remover.

THE RESULTS

Suspended solids reduction ranging from 94.5% to 99.7%. Sludge concentration is easily held to between 1.5 and 2.5% by weight of solids which can be conveniently handled. Higher concentrations are possible, up to 6% having been obtained. Effluent is re-used for process water. Grit is removed from fibers, so that sludge can be re-used in mill.

SKILLED ENGINEERING

and painstaking research are responsible for the ability of Infilco equipment to handle really tough jobs, and contribute to cost-saving and space-saving superiority on any job. That's why outstanding concerns throughout the world invest in Infilco know-how and experience for the answer to their water conditioning, waste and sewage treatment problems.

For further information on the Cyclator write for Bulletin No. S-5650.

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 •

INFILCO INC., *Tucson, Arizona*

FIELD ENGINEERING OFFICES IN 26 PRINCIPAL CITIES

World's Leading Manufacturers of Water Conditioning and Waste-Treating Equipment

Power
COMBINED WITH OPERATING ENGINEER

Let's Dig Out That Scrap

HOW ABOUT some scrap? we asked on this page in September. The shortage of scrap iron and steel for America's blast furnaces was—and still is—endangering the whole war-production program. We urged readers to comb their own plants for unused machines, parts and pieces, to get dead metal back into circulation.

Now a power equipment manufacturer on the Eastern seaboard writes in to tell us how he unearthed an additional hundred tons of scrap after the usual committee could find only 25.

Here's his story, with a practical lesson for all of us: "We appointed a committee that consisted of the shop superintendent and two others connected with the shop. After 'diligent search' they dug up about 25 tons of obsolete equipment and spare inventory. Everything else in sight they claimed was 'either too good to scrap' or 'we may have use for it someday.'

"A few weeks after this committee checked out I walked through the yard for exercise after lunch. Something was wrong; in spite of our big scrap clean-up, a lot of the stuff lying around still looked like junk to me. So a few days later I repeated the tour, with the committee tagging along. I asked them to either scrap a lot more tonnage or tell me exactly *why* they were holding on to the stuff. This time we picked up 100 tons, and lined up some more items that will probably be scrapped within the next few months.

"Now I don't believe our plant is any different from a lot of others. Shop men just hate to let go of any of the old stuff they hope to use on that 'some day' that never comes. These fellows remind me of the way my wife and I hoard things at home in our own basement or attic. Finally the wife gets mad, takes over, and really cleans house. It's a good thing (even though she did give away my new spring coat) and we've got to do just that in our plants—got to get tough and clean out the junk."

The writer of this letter goes on to another good tip: "Recently I have been spending an hour a day going over our inventory list with the interested parties, and have found many tons of idle raw material just sitting around month after month. Now we are getting that back into circulation. For instance, we sold one of our competitors several flanged tank ends and a carload of 6-in. H-beams that are no longer standard for our products.

"Then we found that we were greatly overstocked on a certain type of steel tube. These tubes are going right back on the market and at a good price. That means money in the bank for us and good metal and metal products back in circulation to back up America's defense program."

Did you run a scrap drive in your plant? If so, did you collect metal or excuses? If excuses, how about making another try and being hard-boiled about it?

Phil Swain

Only Edward Has Integral Seats

FOR ALL HIGH PRESSURE—HIGH TEMPERATURE REQUIREMENTS

Pioneer in the valve industry in the use of Stellite hard facing for seats and disks, only Edward has the experience and the intricate equipment to build trouble-free extreme service valves with integral hard facing in a full size range.

No more leakage between valve seats and bodies, no more loosened or distorted seats, regardless of pipe size, service, or valve type.

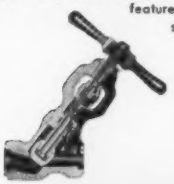
For high pressure—high temperature service, integral valve seats pay for themselves a dozen times over. So, Edward makes them standard construction in the higher temperature ranges, optional for moderate temperature service, and has them available in globe, angle, gate, non-return, instrument and other valve types in a full size range. Integral seats are leakproof seats. There are no threads to corrode—no points for erosion to start—no welds on seat rings to fail. An integral seat valve in a clean piping system needs no maintenance—no replacement.

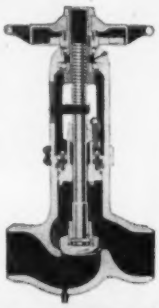
For sizes, types and ratings write for Edward catalog 104.

EDWARD—"BIRTHPLACE OF BETTER VALVE DESIGNS"

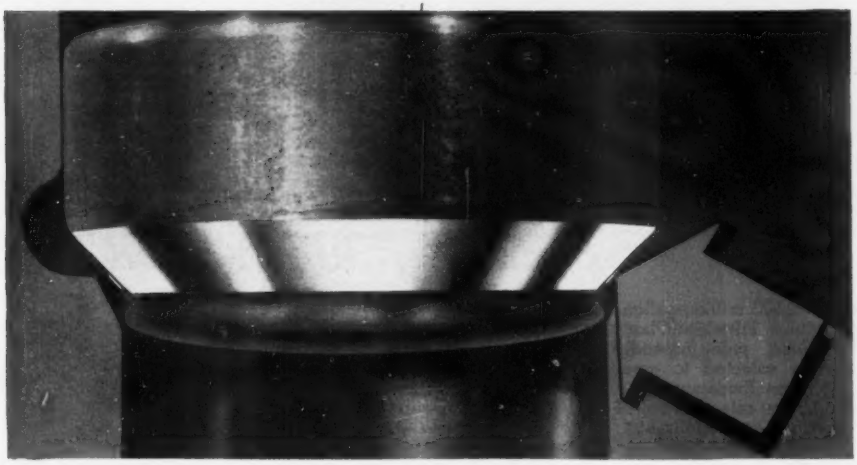
In a Full Range of Valve Sizes

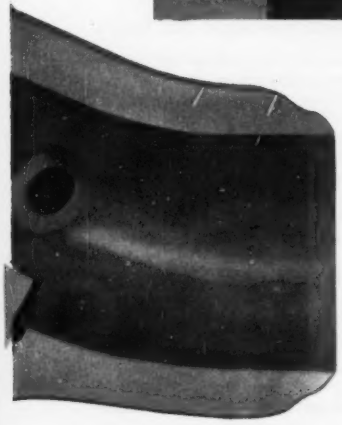
Specify Edward valves with integral, hard-surfaced seats across the board, for Edward and only Edward gives you this permanently tight, leak-proof feature in every steel valve size from ½ in. to 16 in.





See how the Edward integral seat is part and parcel of the valve body itself. Stellite is applied by weld deposit on the machined valve body seat area. The entire body is then heat treated to remove stresses and prevent distortion. Next, the seat is machined to mirror-smooth finish and exactly mated to the hard faced disk.





FEATURES LIKE THIS SAVE YOU TIME, TROUBLE AND MONEY...

IT PAYS TO SPECIFY EDWARD VALVES

WITH AN INTEGRAL SEAT THERE ARE ***NO LEAKS*** *BETWEEN SEAT AND BODY*

Another Product

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

In the City of Cleveland's NOTTINGHAM FILTRATION PLANT

9 vital services are safeguarded with BYERS WROUGHT IRON PIPE

In this modern 100 million-gallon-daily Nottingham Filtration Plant, Cleveland, Ohio, pipe materials were carefully selected to meet service conditions. Evidence of this is provided by the selective use of genuine wrought iron pipe in nine essential services to forestall the maintenance threat of early failure and costly replacement. Over 120 tons of Byers Wrought Iron pipe was used for steam and return piping, hot and cold water lines, leaders, vents and drains, surface wash water piping, railings and miscellaneous services. This time-tried material was installed in the Administration Building, Chemical Building and Filtration Plant. Portions of the installation are shown in the pictures above. Havens and Emerson, Cleveland, Ohio, were responsible for these sound specifications, under the direction of the Utilities Department, of which Emil J. Crown is the Director.

The selection of genuine wrought iron for these services follows accepted design practice, and is endorsed by performance records that testify to the material's superior corrosion resistance. Engineers have applied genuine wrought iron to practically every "hot spot" in modern plants. The record speaks for itself.

Our Bulletin, WROUGHT IRON FOR PIPING SYSTEMS, discusses some of the corrosive conditions found in various services, and illustrates a few of the many places where genuine wrought iron has helped reduce maintenance costs. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of genuine wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

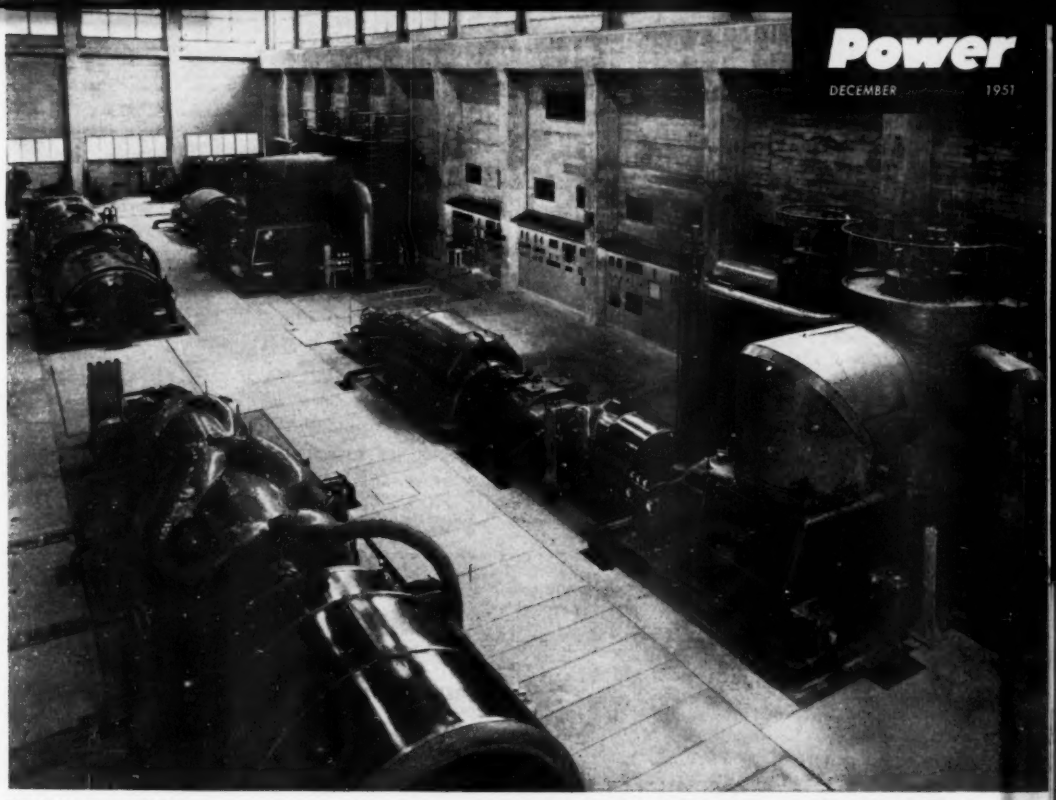
BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



BEZNAU, SWITZERLAND plant holds record for being largest gas-turbine station in world with two units totaling 40,000 kw

Gas-Turbine Plants Line Up for Review

Proof of the gas turbine lies in its running • Here's a quick roundup of operating experience with Brown Boveri plants in far-flung places • Lusty power infant grows up

► AT THE ASME ANNUAL MEETING in Atlantic City, N. J., Paul Sidler, president, Brown Boveri Corp, New York, told the long awaited story about the service performance of their gas-turbine units. He concluded that most of the troubles were "growing pains." Once the source of trouble was recognized, the remedy was easy to find.

Table on page 73 gives essential data for Brown Boveri installations. Efficiencies are based on lower heating value. Total production is for period ending July 31, 1951.

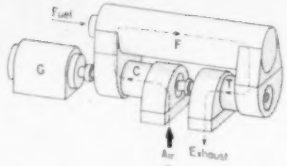
Neuchatel—first commercial unit

Installed as standby and peak-load unit, it has never been needed in emergency and only rarely for peak loads. With its small accumulated running time no troubles have arisen. The unit runs once a month for several hours to check its availability and keep operators trained. These runs also check the semi-automatic controls. Diesel oil is the fuel raising inlet gas temperature at the turbine to 1020 F.

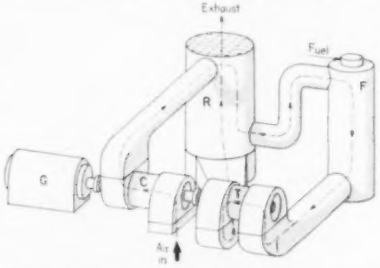
Locomotive—Swiss federal railways

The first gas-turbine locomotive has run in Switzerland, France and Germany with periods of idleness enforced by lack of oil supply. During the early years the refractory lining of the combustion chamber failed from chemical reaction with ash, aggravated by vibrations in rail service. After several replacements this trouble was avoided by installing an all-metal combustion chamber.

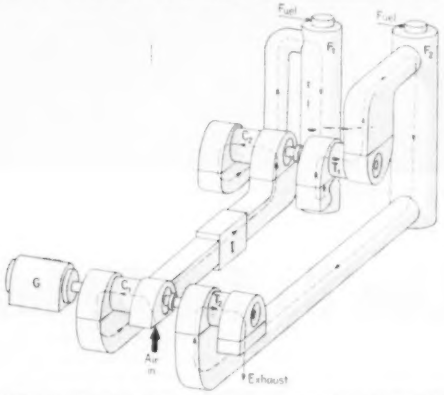
Soot deposits in the regenerator caught fire twice. This hazard has been eliminated by washing the regenerator every 3 to 4 months as a maintenance routine. This can be



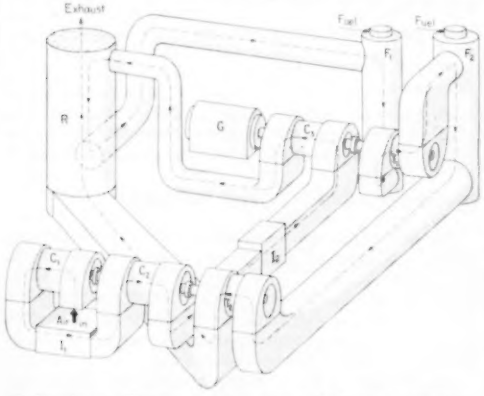
1 Single-shaft single-stage open-cycle gas turbine needs minimum investment; use with cheap fuel or for standby service



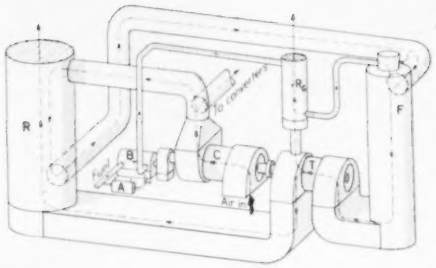
2 Adding regenerator raises plant efficiency to justify using more costly fuel. Plant layout uses low number elements



3 Two-shaft plant with two-stage compression, intercooled, and two-stage heating is another method of improvement



4 Maximum efficiency plant uses two-shaft setup with three-stage intercooled compression, regenerator, and reheating



5 Gas-turbine driven converter blower uses blast-furnace gas for fuel pressurized in compressor driven through gear

KEY TO SCHEMATIC GAS-TURBINE PLANTS

A—Fuel-gas aftercooler
B—Fuel-gas compressor
C—Axial-flow compressors
F—Combustion chamber
G—Main electrical generator
I—Intercooler
R—Regenerator
Rg—Fuel-gas regenerator
T—Gas turbine
Subscripts give order of flow

done in a few hours. Recent increase in uniformity of oil quality has reduced cleaning frequency.

Beznau—largest gas-turbine station

This plant was designed to supplement hydro power during winter months. Anticipated running time was 1200 to 3000 hr per year. The first unit is 13,000 kw, the second 27,000 kw, front and rear units respectively, picture p 71, making this largest gas-turbine station in world.

First troubles on the 13,000-kw set were frequent breaking of the turbine blades. Increased sensitivity of high-temperature alloys to the notch effect was uncovered as the basic cause. A new design of blade root with integral spacer pieces solved this problem. The design proved itself in this and other machines over several thousand operating hours.

After 2000 hr, the same sensitivity showed up in one of the gas-turbine rotors in the form of a crack in one of the blade slots. Simple design changes reduced the stresses at the bottom of these slots substantially. Again several thousand running hours proved these changes effectively.

Blade breakage in the h-p compressor was traced to self-induced vibrations. Damping wires as used in long steam turbine blades eliminated this headache.

When these disorders were corrected by spring 1949, hard crust deposits began to form on the blades of the medium- and high-pressure compressors. These deposits built up steadily causing compressor efficiency to drop off. These crusts had to be removed by hand, a costly maintenance method.

The culprit was discovered to be exhaust gas reentering the circuit at the air inlet despite careful plant layout. This depended on weather and wind conditions. Corrosion products formed by the gas attacking the intercooler interior laid the deposits on the downstream-compressor blades. Design changes in the intercooler cured this worry. No further deposits have formed since then.

Soot deposits in some of the regenerators ignited many hours after the turbines were shut down. The fires destroyed the tubes. This danger exists only when neither air nor gas flows through the regenerator. These elements are now washed regularly and the outlet temperatures are periodically checked for a long period after shutdown. A soot blower

OPERATING EXPERIENCE: GAS-TURBINE PLANTS

Item	Installation	Capacity, kw	Fuel	Overall efficiency, %	Year started	Total hours run	Total production 1000 kwhr	Cycle like Fig. No.
1	Neuchatel, Switz.	4,000	Oil	17.3	1940	1,300	2,350	1
2	Swiss Fed Rwys[1]	1,600	Oil	18.0	1941	7,000	300,000[2]	2
3	Beznau, Switz.	13,000	Oil	30.5	1948	5,844	52,681	4
4	Chimbote, Peru	4,000	Oil	19.5	1949	3,325	1,439	1
5	Alexandria, Egypt	1,200	Oil	22.9	1949	2,000	1,600	2
6	Pertigalete,	1,650	Oil	25.0	1949	7,780	9,295	2
7	Venezuela	1,650	Oil	25.0	1949	6,560	7,295	2
8	Lima, Peru	10/12,000	Oil	28.0	1949	6,225	45,876	4
9	Beznau, Switz.	27,000	Oil	34.5	1949	3,001	55,838	4
10	British Railways[1]	1,840	Oil	18.0	1950	1,100	35,000[2]	2
11	Baracaldo, Spain	2,000	Blast-	25.0	1951	300	510[3]	5
12	Dudelange, Luxmbg.	5,400	f gas	21.5	1951	1,000	5,300	2
13	Filaret, Romania	10,000	Nat gas	23.5	1951	250	1,250	3

[1]Locomotive unit [2]Miles traveled in regular train service [3]Furnishes compressed air

has now been developed that may be operated during service. The design has been thoroughly tested at Beznau.

Ash deposits on turbine blades are soluble in water. They may be quickly removed as needed by built-in washing devices. The Beznau units are shut down from Saturday evening to Monday morning every weekend. The deposits are washed off every fourth Monday morning prior to starting up.

Type of fuel oil burned affects the life of certain portions of the combustion chamber liner. These sections must be replaced in the flame zone after 1500-2000 hr operation. The replacement takes only a few hours.

Chimbote, Peru—simple cycle unit

Actual energy requirements are below anticipated levels. The set runs about 10-12 hr per day at 400-500 kw load, about 10-12% of its capacity. No troubles have arisen.

Alexandria, Egypt—smallest frame size

This unit serves an ice plant with seasonal operation during spring and summer. Initial combustion troubles with the extra-heavy fuel oil were solved promptly by improved preheating and filtering. No other troubles arose.

Pertigalete, Venezuela—cement plant

These two sets are sole source of power for a cement plant, running alternately for one-month periods. The 1650-kw units carry short time peaks up to 1800 kw. Control equipment keeps inlet gas temperature at an average of 1112 F. On Sundays with most of plant shut down, the starting diesel takes care of remaining load, 200-250 kw.

Built-in washing devices in regenerators and turbines make these units easy to clean during shutdown periods. Viscous filters on the air inlets have prevented entrance of cement dust and kept compressor blades absolutely clean.

Fuel consists of mixture, 60% bunker C and 40% diesel oil. Despite high vanadium pentoxide content of this mixture no disorders have been found here as in other oil-burning plants. A 5000-kw unit will be installed in this plant in 1952 and will be fired with natural gas.

Lima, Peru—two-shaft unit

During the dry season from July to January 1950-1951, this unit ran continuously with an average load of 9000 kw, except for brief shutdown of a few hours every 4-5 weeks for inspection. No ash, corrosion or wear disorders have arisen in burning light diesel fuel oil.

Crust deposits on compressor blades and self-induced vibrations of these blades were found in this plant as in Beznau. They were corrected by the same means. Built-in soot blowers in the regenerators are worked every second day during operation. The set has been operated over 120 times from cold start during the peak-load season (3-month period) without ill effects.

Baracaldo, Spain—air compressor

This set supplies air for a converter in a steel mill. Fig. 5 shows net output is in form of compressed air, 26,500 cfm at 29 psig, equaling a driving power of 1600 kw. In the interests of simplicity, the gas turbine uses air at the same low pressure. Total air volume handled is about 83,000 cfm, making useful air about 32% of total. Large changes in air demand by the converter affect total flow through compressor only slightly.

When air demands drops suddenly, momentary surplus from compressor is blown through suitable stage of turbine to recover the energy. Blast-furnace gas available at atmospheric pressure is compressed in a centrifugal blower driven through a gear by the main shaft. Combustion pressure runs at about 65 psig. Nothing unusual in operation has developed.

Dudelange, Luxembourg—steel-mill plant

This unit burns blast-furnace gas. An axial-flow compressor geared to the main shaft compresses the gas before burning. No troubles apparent to date.

Filaret, Romania—natural-gas fired

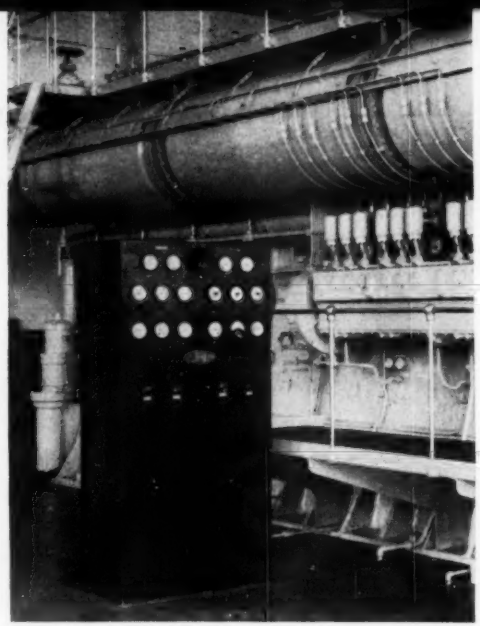
Trial runs have been successful with no trouble apparent up to now.

(*Continued on page* 210)

Diesel Instruments And Controls: 11

By **EDGAR J. KATES**, *Consulting Engineer, New York, N. Y.*

Shutdown and alarm go hand in hand. A good shutdown system should stop equipment to prevent damage, and point out trouble for fast repair. For your diesel setup, here's a handy outline to brief you on mechanical and electrical . . .



GAGE-ALARM CUBICLE with both horn and indicator lamps on easily read panel in large utility diesel-generating plant

Emergency Shutdown Systems: How They Work

► SAFETY DEVICES for diesel engines fall into two classes: (1) alarms to give warning of trouble, and (2) shutdown devices to stop engine before damage is done.

Shutdown Methods. Diesel engines may be shut down by: (1) stopping fuel supply to injection pumps (2) stopping action of the injection pumps themselves (3) holding exhaust valves open, or (4) shutting off air supply.

Stopping Fuel Supply. This can easily be done automatically by using a solenoid valve, Fig. 1, in the fuel-supply line close to the injection pumps. Such solenoid valves are generally open when energized and are, therefore, used with closed-circuit control systems. If the circuit is interrupted, the valve closes.

Shutting off the fuel supply has, however, two possible faults. First, the engine may continue to fire for an appreciable time on fuel stored between the solenoid valve and the injection pumps, unless design includes an automatic drain. Second, while engine is decelerating after injection pumps run short of fuel, pumps may suck air, thus interfering with fuel injection when the engine is restarted.

Stopping Injection. This common method shuts down engine quickly by stopping action of fuel-injection pumps. It also keeps pumps from becoming airbound. Actuating device may be a spring, released by an electrically or mechanically operated latch, or it may be a solenoid. In either case, actuating device will open a spill valve or move the injection pump's control rod or shaft into its shutoff position. If it works on the fuel-regulating mechanism, the spring must be strong enough to overcome the governor force acting on the control linkage.

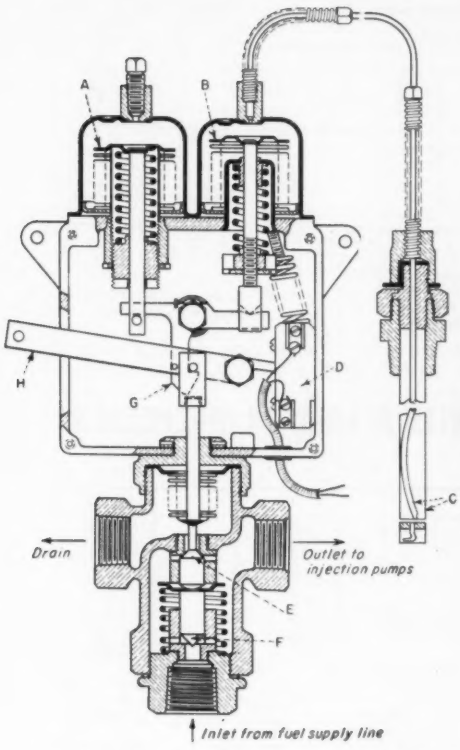
Holding Exhaust Valves Open. This is an excellent way to stop diesel engines. Without compression in the cylinders, the fuel won't ignite, so firing ceases at once.

This method also has the advantage of being able to stop an engine even when it is receiving excessive fuel, as might occur, for example, if injection-pump control jammed, or if oil or gas got into engine air intake.

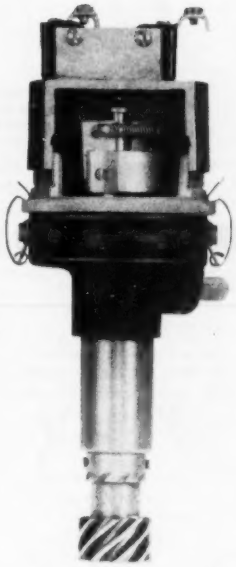
This system is not in general use, however, since the mechanism for holding the exhaust valves open is usually of such design that it must be built into the engine at the factory.

Shutting Off Air Supply. An engine will stop if it doesn't receive oxygen to burn the fuel. Shutdown devices working on this principle close a valve in the air-intake line. The valve, of the butterfly type, is closed by a weighted lever normally latched in the open position. It must close tightly when tripped. If it doesn't, powerful vacuum produced by engine will draw in enough air to keep unit running. Cost is rather high.

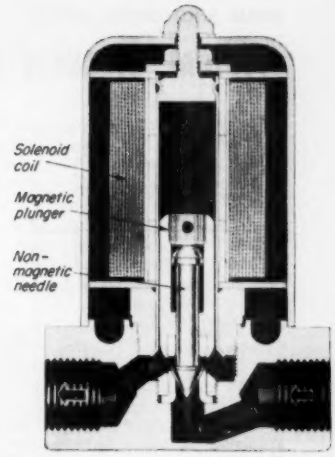
SHUTDOWN-SENSING DEVICES AND ACTUATOR



2 Mechanical safety control: bellows set at safe minimum lube pressure, maximum jacket temperature



3 Centrifugal overspeed stop closes contacts



1 Solenoid valve goes in fuel line for automatic emergency fuel cutoff

4 Overspeed control designed to be attached to outlet for tachometer

SHUTDOWN PRINCIPLES

Depending on nature of fault, shutdown should be either *immediate* or *delayed*.

Immediate shutdown is called for in case of (1) overspeeding or (2) *internal* fault in generator. Overspeeding is too dangerous to allow delay until operator can take action. If an internal fault occurs in generator, engine should be stopped at once to prevent power being generated and fed into the fault, and also to prevent further mechanical damage if a rotor coil has loosened.

Delayed shutdown is often desired where an alarm system gives warning of high water temperature or low lube-oil pressure. Frequently operator can correct trouble before there is any immediate danger to engine, thus avoiding damage or inconvenience that an emergency shutdown might cause.

Delayed shutdown can be effected by: (1) separate fault-switches for alarm and shutdown, with shutdown switches set for higher water temperature or lower lube-oil pressure than alarm switches, or (2) common fault-switches for both systems with a time-delay device incorporated into shutdown circuit.

Although not essential, shutdown system should give standing indication to identify source of trouble so operator won't have to search for it.

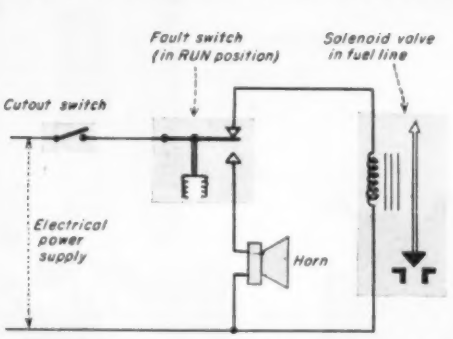
Where engine drives a generator in parallel with other units, shutdown system should connect with trip coil of generator circuit breaker to disconnect generator from bus as soon as engine begins to stop. This prevents reverse-current flow and "motoring."

SHUTDOWN-SENSING DEVICES

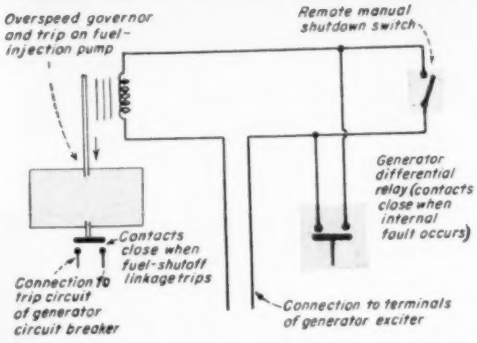
Shutdown systems may be entirely *mechanical*. Fig. 2 shows a mechanical safety control that shuts off fuel supply to injection pumps if jacket-water temperature goes above or lubricating-oil pressure goes below the safe point. By draining oil left in fuel line between shutoff valve and injection pumps, engine is caused to stop firing quickly. It also provides an additional safety feature: should either the oil-pressure assembly or the thermostat assembly develop a leak due to accidental injury, the safety control automatically trips to shutdown position.

Operation is as follows. *A* is a bellows actuated by the lubricating-oil system. *B* is a thermostatic bellows actuated by vapor pressure of a volatile liquid in thermostatic bulb *C*, inserted in the engine water jacket or discharge line. In normal engine operation, control mechanism is in position shown. Should lube-oil pressure fall or cooling-water temperature rise to tripping point for which safety control is adjusted, trigger arrangement *G* will release

TYPICAL CIRCUITS FOR SHUTDOWN, ALARM, AND CIRCUIT BREAKING

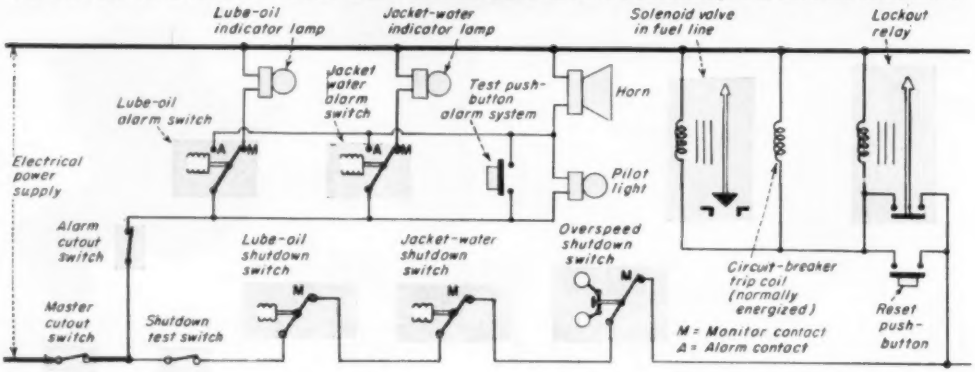


5 Simple shutdown-alarm system has double-throw fault-switch, de-energizes solenoid valve in fuel line for shutoff

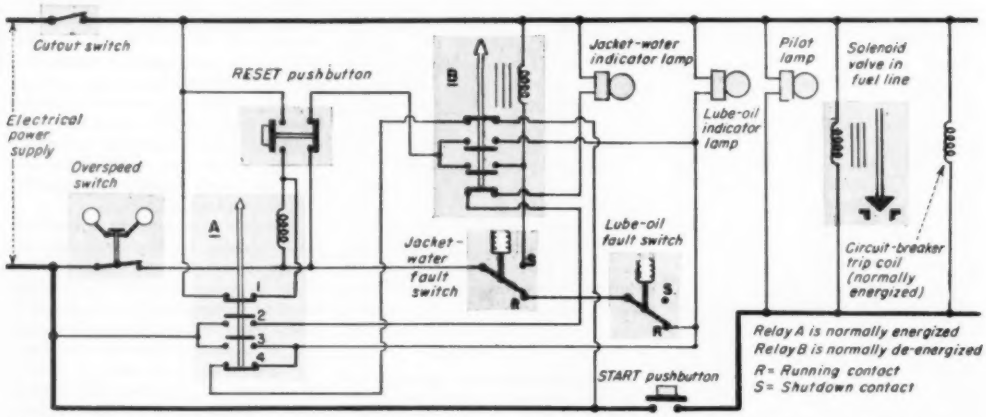

Overspeed governor and trip on fuel-injection pump
Remote manual shutdown switch
Generator differential relay (contacts close when internal fault occurs)
Contacts close when fuel-shutoff linkage trips
Connection to trip circuit of generator circuit breaker
Connection to terminals of generator exciter

8 Shutdown circuit also opens generator circuit breaker in case of internal fault in generator, or engine overspeed

SHUTDOWN CIRCUIT CAN BE COMBINED WITH ALARM, OR INDEPENDENT



6 Shutdown circuit with separate fault-switches for shutdown and alarm. Different control settings allow a time lapse between warning and cutoff for operator to correct trouble. Circuit must be complete before engine can be restarted



7 Four-pole-relay shutdown circuit gives standing indication, independently of alarm system, of trouble that caused it to function. This circuit does not allow time between occurrence of trouble and shutdown for operator to remedy fault

spring-loaded lever assembly *H* to instantly close supply port *F* and open drain port *E*. Engine will then stop.

When normal conditions are restored, safety control is manually reset by lifting lever *H*. The trigger will not engage until trouble that caused control to trip is rectified. When starting the engine, operator must lift lever *H* by hand to hold fuel-supply open until lube-oil pressure reaches normal. Note that fuel line drains whenever engine stops. If this is objectionable, drain connection may be plugged.

Switch *D* closes when safety control trips. It may be used to operate an audible or visible alarm system (without identifying trouble source) or to start emergency power equipment. To give advance warning of trouble before shutdown device trips, an independent alarm system is necessary.

Electrical shutdown-system sensing devices for checking temperature or pressure are fault-switches like those used for alarm systems (POWER, Oct 1951, p 82). Overspeed stops employ contact-making centrifugal devices, which may be gear driven, Fig. 3, or attached to the outlet for a tachometer, Fig. 4. Another arrangement uses a snap switch installed inside a tachometer and actuated by its speed-responsive shaft.

Differential relays are used to protect large generators from internal faults. These relays operate by comparing amount of current flowing at one end of any given phase winding with that flowing at other end of same phase winding. Should a phase winding become grounded or short-circuited to another phase winding, the resulting difference in current flow causes differential relays to open or close a control circuit. This trips the main circuit breaker to prevent further flow of current to or from the main bus, and simultaneously actuates the engine shutdown mechanism.

Sometimes the shutdown system for electrical trouble is combined with an overspeed stop, and the entire arrangement is made independent of the usual oil and water alarm systems.

TYPICAL SHUTDOWN CIRCUITS

Fig. 5 shows a simple circuit using a double-throw fault-switch. Upper contact, which is normally closed, energizes solenoid-operated valve to permit fuel flow to injection pump. When fault-switch operates, fuel supply shuts off and engine stops. Also, lower contact closes, sounding horn signal (or lighting a trouble lamp).

If fault-switch guards lubricating-oil pressure, it's necessary to move the switch manually into the RUN position (shown in diagram) each time engine starts. This opens solenoid valve and feeds fuel to engine while lube-oil pressure builds up to normal. Note that when engine stops, whether because of fault or not, fuel valve closes while the engine is still turning over. This could result in the fuel line becoming airbound.

Shutdown After Alarm. Fig. 6 shows a shutdown circuit employing separate fault-switches for shutdown and alarm. Switches have different control settings so, when fault occurs, alarm sounds and indicator lamp identifies trouble source, giving operator chance to rectify it before shutdown. If trouble reaches danger point, second fault-switch closes solenoid fuel valve to stop engine, and de-energizes circuit-breaker trip coil to disconnect generator from bus. Lockout relay prevents restarting engine or reclosing circuit breaker until all shutdown fault-switches are back in normal position and lockout relay has been reset by pushbutton.

Both alarm and shutdown system are closed-circuit and self-monitoring. Illumination of pilot light and indicator lamps shows that alarm system is in working order. In shutdown system, the engine cannot run unless all shutdown switches are normal (closed) and all circuits are complete. Note that immediately after emergency shutdown caused by hot water, the water indicator lamp in the alarm system will be out, identifying this particular trouble. The lube-oil lamp, however, will always be found extinguished when the engine is stopped.

Independent Shutdown. Fig. 7 shows a shutdown system independent of an alarm system. It gives standing indication of trouble that caused it to function. This is done by means of two 4-pole relays, *A* and *B*. With system in operation and all conditions normal, relay *A* is energized, relay *B* is not. Shutdown switches are in running position *R*. Indicator lamps and pilot lamp all burn, and current flows through fuel-valve solenoid and through trip coil, which keeps the circuit breaker closed.

If jacket water overheats, its fault-switch opens contact *R* and closes contact *S*. Opening contact *R* extinguishes cooling-water indicator lamp. Closing contact *S* energizes relay *B* which rises, interrupting circuits through solenoid fuel valve and circuit-breaker trip coil while maintaining the circuit through lube-oil indicator lamp. Once energized, relay *B* remains so, even after jacket-water fault-switch returns to normal position *R* and until *B* is de-energized manually by RESET pushbutton.

If lube oil fails, its fault-switch opens and interrupts, directly, current flow through solenoid fuel valve, circuit-breaker trip coil, and lube-oil indicator lamp. The cooling-water indicator lamp remains lit. The lube-oil indicator lamp will, of course, stay out while engine is stopped since there will be no oil pressure.

Overspeed Operation. Relay *A* functions only in case of overspeed or loss of power to the shutdown system. When overspeed switch opens, it de-energizes relay *A* which drops, causing its contact to act as follows: Contact 1 opens circuit through solenoid fuel valve and circuit-breaker trip coil. Contacts 2 and 3 keep lube-oil and cooling-water indicator lamps lit. Contact 4 locks out relay *A* in de-energized position. The RESET pushbutton serves to re-energize relay *A* after overspeed trouble has been corrected and overspeed switch has returned to normal (closed) position.

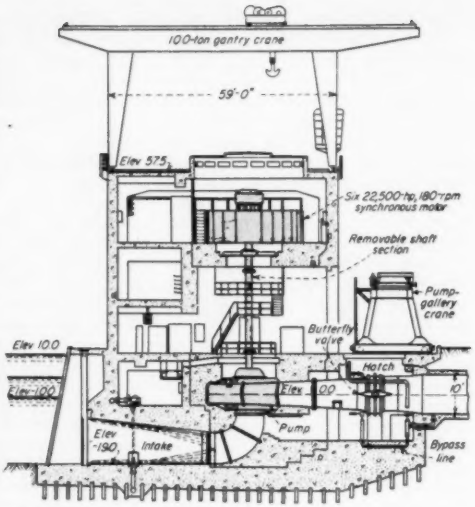
The engine cannot start until power is returned to the shutdown system. Operator must push both START and RESET buttons. START button energizes solenoid fuel valve until lube-oil pressure rises to normal, thus closing lube-oil fault-switch. Then relay *A*, energized by the RESET button, keeps the fuel valve open.

Internal Fault. Fig. 8 shows a circuit for stopping engine and opening generator circuit breaker in case of internal fault in generator or engine overspeed. It also provides for remote manual shutdown, which is useful for fire emergency. Engine design includes overspeed governor, which can operate trip in the fuel-injection-pump linkage to stop engine. To this are added (1) a solenoid that, when energized, trips the same fuel-pump shutoff linkage, and (2) a pair of contacts that close when pump linkage is tripped, thus tripping generator circuit breaker. Consequently, engine stops and breaker opens when either the overspeed governor functions or the solenoid is energized. The solenoid is energized when generator differential-relay contacts close because of internal fault, as previously explained, or when someone closes the remote manual switch.

PARTING WORD

With this, the eleventh article, the series on Diesel Instruments and Controls, which began in the June 1950 issue, comes to a close. Writing this series has been a lot of fun, not "blood, sweat, and tears." You probably haven't found the articles studded with pearls of wisdom, but they do contain some practical pointers based on long acquaintance with diesel-plant design and operation. If one or more of these articles have helped you, the series has served its purpose.—*E J Kates.*

PUMP IMPELLER. Made of bronze, weighs 37,000 lb. The beautiful lady in the suction eye gives a good idea of its size



PUMPING PLANT. Cross section of the plant through one unit shows crane on right used to dismantle and assemble the pumps

3 Billion Gpd Pumping Plant

Six 350,000-gpm pumps, each driven by 22,500-hp synchronous motors, are part of world's longest mass water-movement project

► NORTHERN CALIFORNIA has water to spare, whereas the southern half of the state is deficient. It was to correct this condition that the U.S. Bureau of Reclamation started the great Central Valley Project 15 years ago. This $600 million development reached one of its important stages when the Tracy Pumping Plant went into operation recently. This plant, near Tracy, Calif., takes water from the lower Sacramento River and delivers it to the thirsty San Joaquin Valley through the 120-mile Delta-Mendota Canal. The two valleys measure 500 miles in length and make this project the *longest* mass movement of water ever attempted by man.

Pumping Plant. In size Tracy Pumping Plant, with six 22,500-hp pumps, is second only to the mammoth pumping plant at Grand Coulee Dam. POWER, May, 1951. It has a capacity of 3 billion gallons per day against a 200-ft head. Pumps are vertical-shaft single-stage bottom-suction closed-impeller centrifugal design, built by Worthington Pump & Machinery Corp. Each pump is rated 767 cfs (350,000 gpm) against 197-ft total head, but can operate over a head range of 174 to 204 ft and be stable.

Impellers are bronze, 145 in. in diameter, and weigh 37,000 lb each finished. Pump casings have an average diameter of 18 ft, made of cast iron in four sections bolted together. Above its main stuffing box, each pump has a guide bearing, oil lubricated by motor-driven circulating pumps.

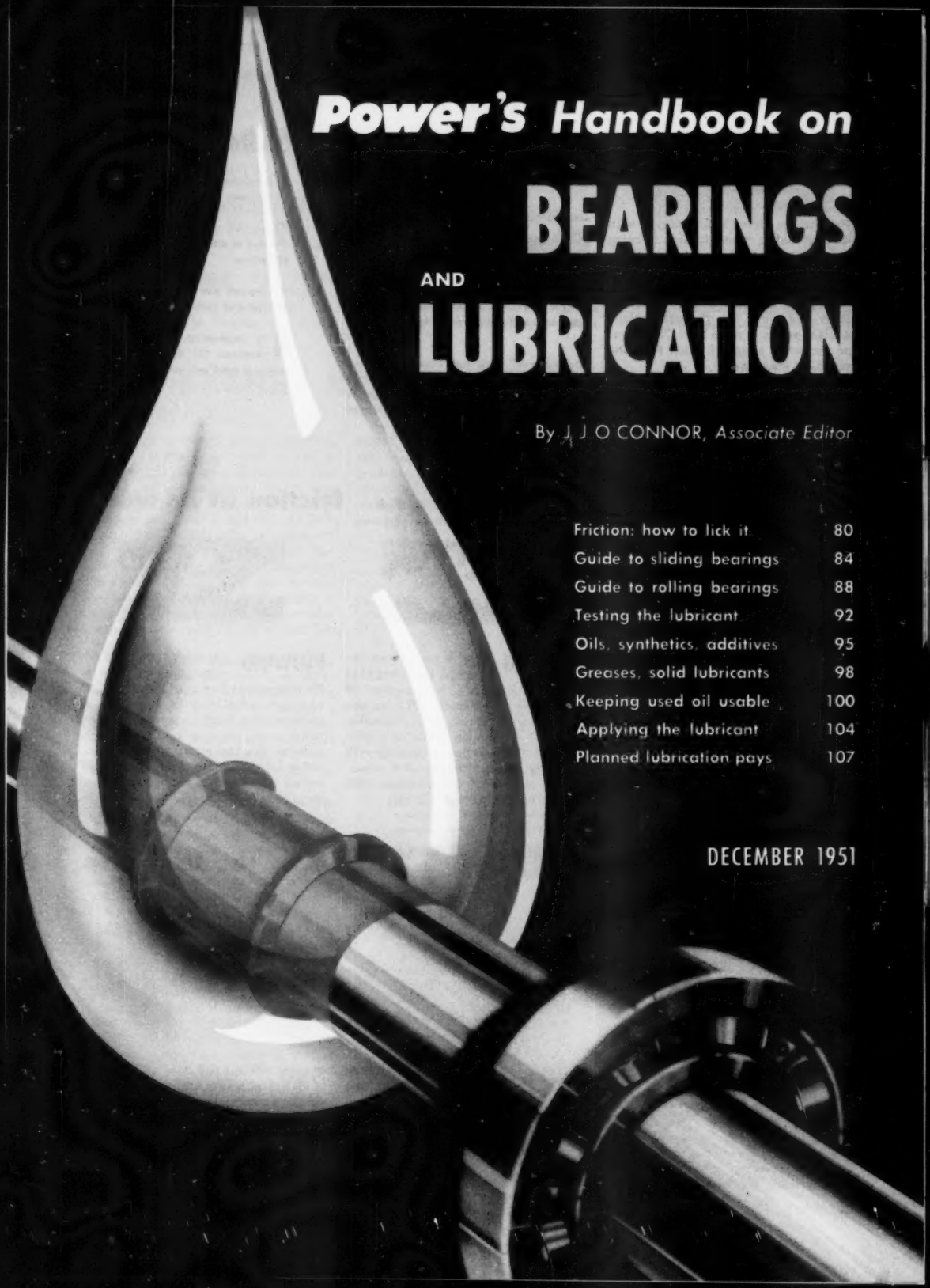
As shown in the drawing, the pump shaft connects to the motor by a long section with integral couplings for bolting to the pump and motor. The crane at right can remove this section, after which the pump can be dismantled without disturbing its casing or motor.

Butterfly Valves. Each pump discharges through a butterfly valve 9 ft in diameter into a 10-ft discharge pipe. The six pipes group into pairs that connect to three 15-ft lines about a mile long discharging through siphons into the canal.

An Allis-Chalmers 22,500-hp 13,600-v 0.95-leading-pf synchronous motor drives each pump at 180 rpm. Motors have a diameter over the air housing of 25.5 ft. They are totally enclosed and cooled by air recirculated through four watercooled surface air coolers inside the casing. A carbon-dioxide fire-extinguishing system protects them.

Starting the Motors. Either reduced or full voltage may be used to start and synchronize the motors. When reduced-voltage starting is used under minimum power-system conditions, the discharge valve is closed and the pump casing is unwatered by compressed air. The motor is started and synchronized at reduced voltage, then full voltage is applied.

When starting on full voltage, discharge valve is closed but the scroll case is not unwatered. After the motor comes to speed and synchronizes, the discharge valve is gradually opened. Since the power system on which the pumping plant operates is large and the motor's locked rotor current is only about 375% rated value, full-voltage starting is the accepted method.



Power's Handbook on BEARINGS AND LUBRICATION

By J. J. O'CONNOR, *Associate Editor*

Friction: how to lick it	80
Guide to sliding bearings	84
Guide to rolling bearings	88
Testing the lubricant	92
Oils, synthetics, additives	95
Greases, solid lubricants	98
Keeping used oil usable	100
Applying the lubricant	104
Planned lubrication pays	107

DECEMBER 1951

HOW LUBRICATION LICKS FRICTION

Friction, like taxes, will always be with us. But unlike taxes, friction is being reduced with better surface finishes and lubricants. What is friction? It's usually defined as a force . . . the force that resists sliding motion. We can be fussy and say it acts through a plane at right angles to main load. *Coefficient of friction* is simply friction force divided by main load.

Laws of friction have changed since you were in school. Latest findings upset the apple carts of da Vinci, Amontons and Coulomb. Old "hills and valleys" idea has been somewhat streamlined. With modern fine-machined surfaces important concept is *adhesion* or cold-welding of surfaces in contact.

SMOOTH TO EYE . . . but fine-ground steel edge looks like this under the microscope

Sliding Friction

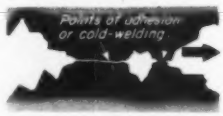
1 is independent of contact area, increases with load

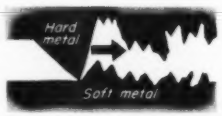
2 depends on sliding velocity and its effect on temperature of surfaces

3 depends also on shear resistance of surface materials

4 is independent of surface roughness for the average range of machined surfaces

MOVING A DRY LOAD . . . friction at its worst



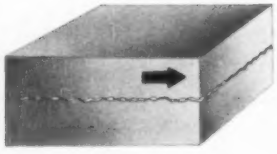


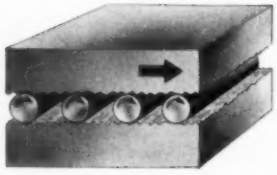
ADHESION Load is carried on many minute surface points that are in contact. With load at rest, weight flattens these points, increasing contact area. This leads to cold-welding at these junctions. Trying to slide one surface means shearing these welded points. Force needed for this accounts for largest part of friction on dry machined surfaces

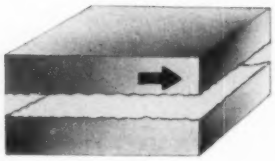
SHEARING For years it was believed that biggest cause of friction was intermeshing of microscopic rough spots. Adhesion was not considered serious. Simple shearing of "hills" by opposite "hills" is a definite part of the picture, especially with relatively rough surfaces. But shearing is secondary to adhesion with modern well machined surfaces

PLOWING Another contributor to total friction force is the digging or plowing of jagged "hills" of a hard-metal surface into a softer-metal surface. Such is case, on a microscopic scale, when a journal rides on a softer bearing metal without separating lubricant film. This factor is in a class with shearing and is also secondary to adhesion

CHANGING FRICTION TYPE . . . the first step





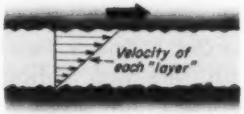


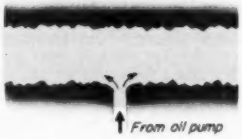
SLIDING This is most basic type of friction—one solid body pulled or pushed across surface of another with adhesion, shearing and plowing coming directly into play. Examples are piston moving in a cylinder or shaft revolving in a bearing with no lubricant separating the surfaces

ROLLING Any system of rolling elements reduces friction considerably. If balls or rollers and flat surfaces were smooth and inelastic, friction would be almost zero. But materials deform, rolling elements slip under load. However starting and running friction are about the same

FLUID When full film of lubricant separates surfaces, only friction is from motion within the fluid. Fluid splits into "layers". Top layer sticks to top surface, bottom layer to lower surface. Each successive layer travels at lower speed, shearing the layers on either side

SEPARATING THE SURFACES . . . oil's big job





HYDRODYNAMIC Full film of oil, exaggerated above, is normally about 0.01 to 0.001 in. for 1-in. bearing—or lower

HYDROSTATIC Oil pressure from outside pump keeps surfaces apart. For slow, heavy loads or to cut down starting friction

THIN-FILM Many bearings will operate with only 0.0001 in. or less oil film between surfaces; some metal-to-metal contact

THE SECRET IS VISCOSITY . . . and here's why

If we're going to talk about supporting loads on a film of oil—and we will in the next two pages—we'll have to jump ahead and talk about an oil's properties. That subject will get a big splash later on (pp 92-94). But for now let's concentrate on getting a clear concept of one oil property—*viscosity*. Viscosity is by far an oil's most important property. It's simply the oil's internal resistance to motion, stubbornness if you will. Oil with a high viscosity won't flow as easily as oil with a low viscosity.

Temperature is important, as shown at right. Oil, like molasses, flows better in June than January. We can now say that a high-viscosity oil can support a heavy load, especially at low temperatures. Then as temperature rises, heat thins the oil, reducing its body or viscosity, until load squeezes it out of bearing.

Then you might assume the sensible thing, say in an internal-combustion engine, is to use a high-viscosity oil since it will support the greater load. It *would* handle heavier loads if it *could* get into present-day thin bearing clearances. But it can't.

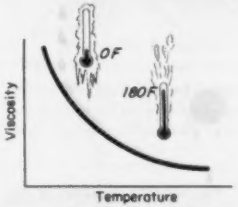
So what's the answer?

Best approach is to use a low-vis oil that, because of improved refining methods, will not thin excessively as temperature rises. And chemical additives help too.

Let's look at a low-viscosity oil at work in a close-fitting bearing. First off, the low viscosity lets the oil creep into small clearances. Then as load is thrown on, the oil will be squeezed between bearing and shaft. But oil resists any big pressure increase by increasing viscosity, as upper-right chart shows. This viscosity increase is believed to account for much of the high load-carrying ability of low-viscosity oil in low-clearance bearings.

QUICK FACTS ABOUT VISCOSITY. When all the cards are down, it's viscosity that has the final say-so on friction loss, heat generation, load-carrying capacity, film thickness, ability to flow, and in many cases wear. Selecting oil viscosity for a specific machine is the job of the machine designer. But as a rule of thumb: low-viscosity oils have lower internal-friction loss, flow more readily into tight bearings where high pressure increases viscosity enough to carry a heavier load

WHAT AFFECTS BEARING LOAD



TEMPERATURE affects oil's viscosity. Thick viscous oils have greater internal friction but can support larger loads than thin oils. An ideal oil would not change viscosity with heat

HIGH PRESSURE increases "vis". That's why you can use a thin (low viscosity) oil in modern equipment and still have it support heavy loads. But high vis increases fluid friction

VISCOSITY must be juggled to handle maximum load without overheating. Increasing vis allows more loading. But higher temperatures would result from increases in fluid friction

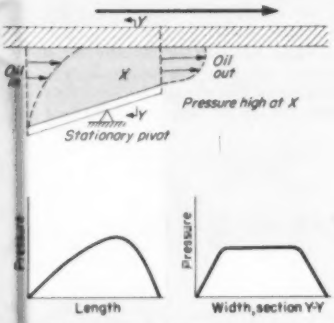
SPEED influences heat formed in bearings; high speed means faster shearing of oil layers. But speed helps oil form cushion in bearing, so higher speeds generally allow higher loading.

HOW OIL SUPPORTS LOAD . . . the "why" of

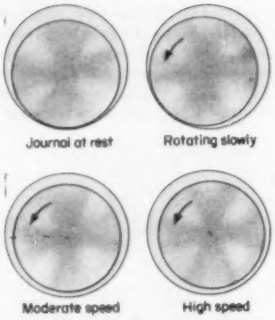
It's easy enough to push a log across a pond but it's not so easy to drag it up on shore. That's just one example of the difference between fluid and dry friction. Real fluid friction exists only with a thick film of lubricant (hydrodynamic or hydrostatic). True, film may be thousandths of an inch or less, but it's still large compared with thin-film lubrication where thickness may be only one molecule of oil. And with thin film, *oiliness* is what counts.

THICK OIL FILM . . . wedges between shaft, bearing

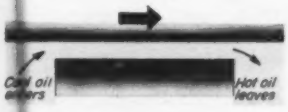
BUILDING PRESSURE IN BEARING



PRESSURE is built up by moving slider dragging lube film into a converging wedge. Principle works for plain and thrust units



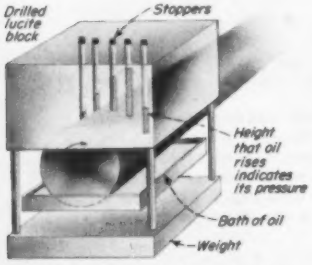
SPINNING SHAFT drags oil into a wedge-shaped layer between journal and bearing, lifting up shaft



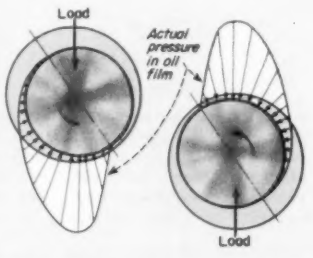
PARALLEL surfaces induce some pressure by heat expansion rather than wedge action; friction heat expands oil

MOTION of surfaces not necessary with hydrostatic system to keep them apart. Pressure lifts shaft to ease starting

HOW LOADING AFFECTS PRESSURE



ACTUAL MODEL of a plastic bearing, sketched above, uses colored oil to show how pressure pattern builds up



LOCATION of pressure pattern depends on where the load is applied. So don't feed oil in at top of bearing on upward loads

Understanding how an oil wedge is formed is *the* important concept in hydrodynamic lubrication. To see why this is important, let's look first at the slider bearing sketch, top far left.

As we learned earlier, oil sticks to both top and bottom areas. And when the top surface is moved, the lubricant film "breaks" into layers like a deck of cards with each layer dragging at the one below it.

Pressure Build-Up. Oil enters the slider bearing at left and leaves at right. Because the two surfaces converge, oil leaves wedge at a higher average velocity than it enters with, as velocity arrows show. So, fluid tends to back up in the wedge-shaped area. But since oil cannot be squeezed into a smaller volume, its pressure builds up instead. Highest pressure is developed in region *X*.

Sliding Bearings. This same wedge principle holds even when the two surfaces curve, as they do in the conventional sliding bearing. The 4-part sketch, left, shows how a wedge builds up during starting, lifts journal off bearing surface and keeps them apart during running. Sketches below show how supporting pressure is distributed.

Note that upon leaving wedge area and entering area where journal and bearing surfaces diverge, oil pressure drops off suddenly. Under certain conditions pressure may fall below atmospheric. Then oil film "breaks" since a liquid cannot withstand tension, and air or oil-vapor bubbles form in diverging section.

Practical Loading. So far we've assumed applied load was constant in both size and direction. But in many machines, say an internal-combustion engine, loading is anything but constant, in size and direction. Especially in the connecting-rod bearings, main crankshaft bearings, camshaft bearings and piston-pin bushings. Reciprocating steam engines, pumps and compressors have similar shifting loads.

When bearing load increases or

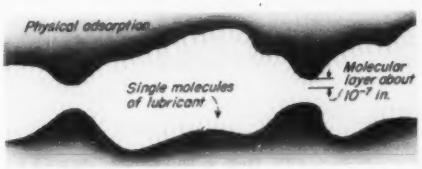
thick- and thin-film lubrication; role of oiliness

changes direction, the shaft will generally shift its position until all the forces are again in equilibrium. This radial motion means part of the oil film will be squeezed and forced to flow around the shaft. But because of its viscosity the oil pushes back against this change in shaft position, like fluid in a hydraulic damping system.

This resistance actually adds to the load-supporting ability of the oil film — that is, as long as the shaft's radial motion continues. However it cannot last indefinitely under a constantly increasing load. But it's very effective in supporting reciprocating loads such as piston pins meet. The high-brow term for this resistance to change in shaft position is the "squeeze-film" component of total hydrodynamic pressure.

High Speed. In most classical lubrication theory, which is what we've been discussing, it is assumed flow in a lubricating film is *laminar* (layer-like). Purely mathematical analysis bears this out. But there's been a change in the picture here only within the past year or so. Experiments on 8-in. turbine bearings with the shaft turning over 10,000 rpm show a sudden increase in friction at a certain point as speed is steadily increased. This critical speed may mark the change from laminar to *turbulent* flow in the lubricant. If so, you can expect some new theories on high-speed lubrication.

THIN OIL FILM . . . calls for tough single "layer"



OIL MOLECULES physically adsorbed to metal surfaces. Friction is caused by the oil molecules rubbing ends

OVERLOADING breaks down lube film, allows metal contact. The molecules may bunch up to help take load

In the thin-film or boundary region, you often find but a single layer of lubricant plating the bearing surface, either by *adsorption* or chemical reaction. Physical *adsorption* is pictured above. Here the individual molecules stand on end with their bottoms attached to the metal surfaces, like barnacles. Their height is only about 0.0000001 in. (10^{-7} in.).

When oils containing *extreme-pressure* additives are used for thin-film lubrication, film is formed by actual chemical reaction with the metal.

In hydrodynamic lubrication the resistance to motion is due entirely to viscosity of the lubricating film. But in everyday practice it is often impossible to keep full-fluid lubrication, especially if the sliding speeds are low or the loads are high. Transition to boundary lubrication may be gradual. As speed drops or load goes up, the lube wedge separating the surfaces becomes thinner and surface peaks begin to penetrate the oil film.

Friction now is influenced by the type of surface as well as lubricant composition. Viscosity plays little or no part in resulting friction.

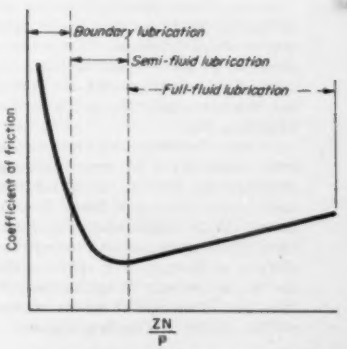
LUBE OILINESS CUTS WEAR, FRICTION IN THIN-FILM REGION

Let's go a little deeper into *physical adsorption*. A drop of pure mineral oil on metal has little tendency to spread or wet. But if a small amount of fatty acid, such as oleic acid, is added to the mineral oil, its characteristics will change. First off, the combine will wet and adhere more readily to metal. Furthermore, friction between metal surfaces lubricated with the mixture will take a big dip.

These changes result from surface activity. Straight mineral oil has little tendency to react or mix with other substances. Fatty acids and other additives (apart from the extreme-pressure additives mentioned above) contain chemical groups that are relatively quite active, are soluble in oil and tend toward solubility in water.

But here is the important point. In contact with metal surfaces the "activated" molecules will orient themselves perpendicular to the surface (as discussed above). No one has figured out just how this is done. But the result is increased *oiliness*.

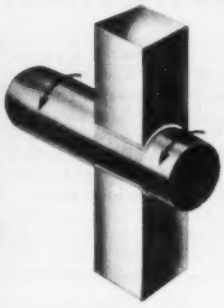
Oiliness is particularly important in the thin-film region. It is difficult to define it mathematically (and frankly, we're not going to try). But for practical purposes, oiliness is the property that causes a reduction in friction and wear in the boundary region, assuming same viscosity and temperature of lube film — important in diesel engines.



SIGNIFICANT curve shows how friction and film thickness relate to viscosity, Z; speed, N; projected bearing pressure, P

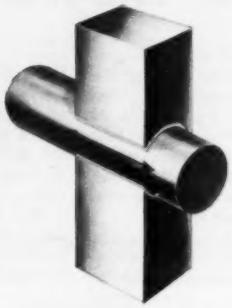
With full fluid film, oil between bearing surfaces shears like deck of cards

BASIC SLIDING BEARINGS ARE . . .



JOURNAL

Part of shaft that turns within bearing is *journal*. Sleeve bearing has soft metal liner on hard base. Bushings often one metal



GUIDE

Here, bearing's job is keeping moving parts in straight line. Typical case would be crosshead assembly in steam engine

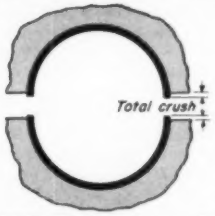
THRUST

This type used where all or part of load parallels the shaft. Example is the lower bearing supporting water-driven turbine unit

TYPICAL PRECISION BEARING: SOME BEARING TERMS

PRECISION bearing is made to insert interchangeably

SPREAD creates side pressure to hold snug during assembly



CRUSH simulates a press fit, holding back tight to bore

PARTING RELIEF keeps edge of bearing from rubbing shaft

GUIDE TO SLIDING BEARINGS

In all sliding bearings, one surface moves relative to another, usually with a lubricant film between. They differ in direction of motion and way load is applied (see sketches above). Journal bearings are most often met; let's deal with them first.

Journal Bearings. You're familiar with construction of sleeve bearings and bushings so let's catch up with some terms you should know. *Bearing factor, ZN/P*, helps predict performance. It's proportional to bearing's coefficient of friction. (*Z* is absolute viscosity, *centipoises; N*, speed, *rpm; P*, load, *psi.*) Low *ZN/P* means thinner oil film, closer to boundary region.

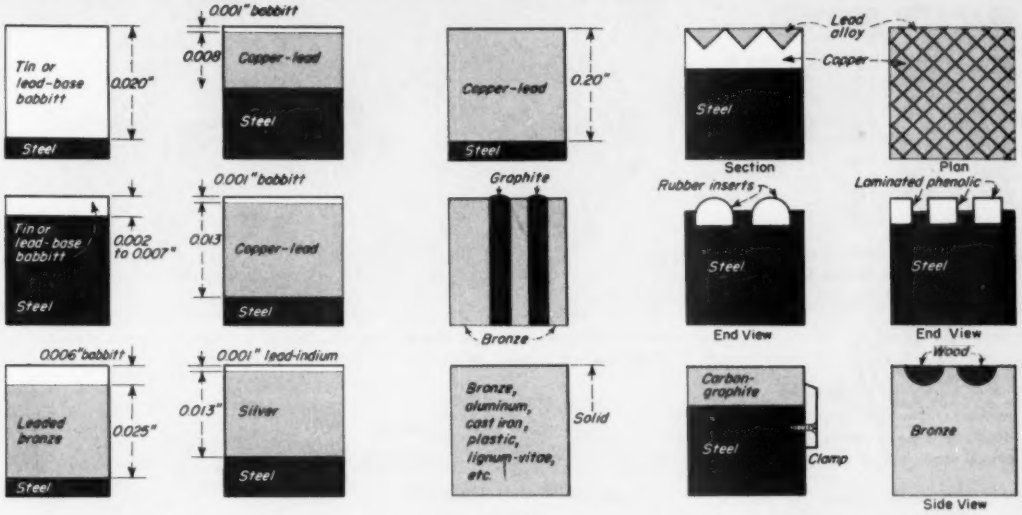
Also used in gaging performance and safety is *rubbing* or *PV factor*. (*P* is load, *psi; V*, shaft speed, *fps.*) Other things being equal, high *PV* spells high temperature.

Clearance. Small clearance means more heat, but greater load capacity; large clearance means less heat but is mechanically undesirable. Hence the designer must select best compromise. Rule of thumb: 0.001 in. diametral clearance for shafts 1-in. dia or less; on larger shafts, 0.001 plus 0.001 for each inch of shaft diameter, up to 0.006 in. Designers sometimes speak of *clearance ratio*. This is *difference* between bearing and journal diameters, *C*, divided by journal diameter, *D*.

Since narrow bearings mean smaller over-all machine size, *length to diameter ratio, L/D*, is usually small. Somewhat greater than 1 for most industrial machinery; usually less for highly loaded engine bearings.

Bearing Construction: Familiar sleeve bearing, with fairly thick lining of high-tin alloy on a stiff backing, still serves well. But high loads and speeds met, for example, in internal-combustion engines have brought changes. So, too, has desire for simpler installation and replacement, without need for hand fitting. Modern precision bear-

MODERN BEARINGS OFTEN USE MORE THAN ONE METAL



TURBINE BEARINGS

Big turbines and generators present a simpler bearing problem than engines. Lead- and tin-base babbitts along with high-lead bronze have worked out well. But tin-base babbitt is preferred generally, having greater resistance to corrosion. Bronze is used in smaller turbines for auxiliary service. Aluminum shows promise

HOW THIN LAYER OF METAL CUTS FRICTION

ings (sketch, left) are fully interchangeable. Following thinking diagrammed above, they have thin linings (0.015 to 0.040 in. for diesels, as low as 0.004 in. for auto engines). Such thin linings carry high loads, show greater fatigue life.

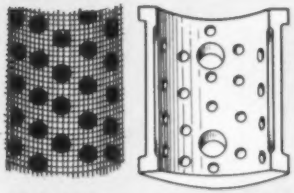
Bearing Materials. If full fluid lubrication always existed, choice of materials wouldn't be critical. But it's always missing during starting and stopping (except where hydrostatic lubrication is used). And with modern high loads and speeds, bearings frequently operate with extremely thin films and some metal-to-metal contact.

Bearing material must meet five tests: (1) It must resist *fatigue* caused by variable loading and heat stresses. (2) It must display *embedability* — dirt entering clearance space must embed in lining, not cut a groove in shaft or bearing. (3) It must have *conformability* — yield or deform slightly to allow for distortions of machine structure under load. (4) It must resist *seizure* on metal-to-metal contact. (5) It must resist *corrosion* by lubricant and products formed in it during service. And, if it is to be used as a lining, it must have *bondability* — give a strong bond with backing material.

Babbitts. The family of white-metal alloys sired by Isaac Babbitt back in 1839 still rates tops in all respects except load-carrying ability. Besides the well-known tin-base babbitts there are now many lead-base alloys, usually hardened with tin-antimony, silver, arsenic, alkali earths. Fatigue resistance of babbitt is improved by using thinner linings, thus bringing stronger backing material close to the point where it can assume a share of load. In *trimetal* bearings (drawings above) a few thousandths of babbitt overlays a leaded-bronze or copper-lead lining on a steel back.

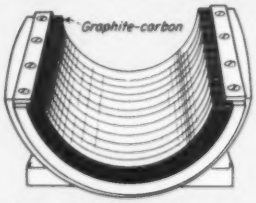
Other Alloys. Stronger materials that take over when loads are too great for babbitt alone usually require harder

GRAPHITED BEARINGS . . .



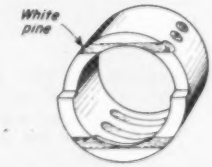
GRAPHITE cones in bronze screening are laid in mold before babbitt fill

GRAPHITE pressed in bronze bearing covers shaft with a lubricating film

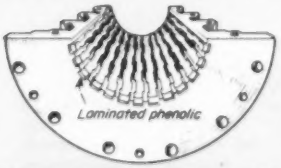


GRAPHITE-CARBON plus binder formed into rings and assembled as bearing

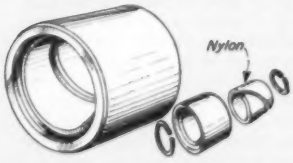
WOOD, PLASTIC, NYLON



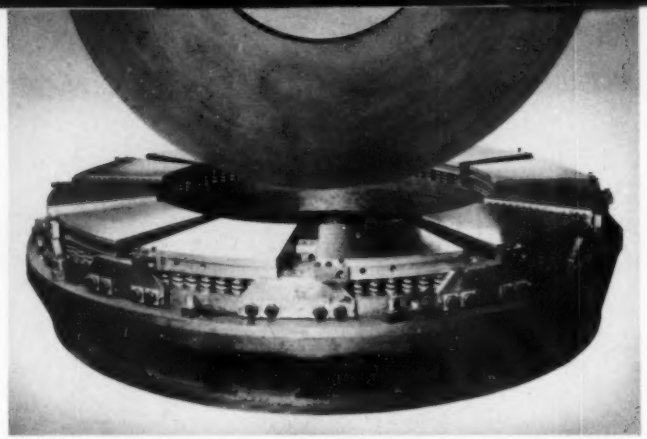
WHITE PINE feeds shaft oil. Woods are also used as bearing materials



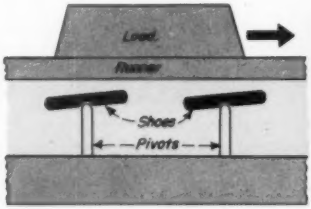
LAMINATED PHENOLIC plastic lubricated by water finds wide marine use



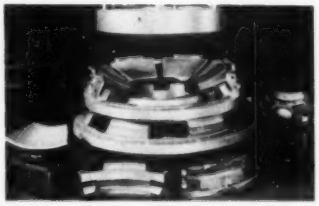
NYLON serves as inner lining wrapped by metal; split allows expansion



THRUST BEARING of large vertical machine. Runner attaches to shaft; stationary pads rest on springs. In rotation, a full fluid film separates pads and runner



WEDGE principle of pressure buildup is applied directly in thrust bearings



SPHERICAL thrust bearing has 6 shoes. Horizontal thrust units also available

shafts, more and cleaner lubricant, better journal-surface finish and greater constructional accuracy. Leaded bronzes are centrifugally cast, to form one piece bearings, or used on a steel back. They are also used with a thin babbitt overlay or in a gridded construction – surface indentations filled with silver-lead babbitt.

Copper-lead alloys, while susceptible to corrosion by lubricant acid products, show high strength. Used alone, they require hardened journals. They often serve as intermediate layer of trimetal bearings, with a plated overlay of babbitt. Cadmium-silver copper and cadmium-nickel also require hard shafts. Silver is used in bearings, with a lead-tin or lead-indium plated run-in surface. Aluminum alloys look good for use in one-piece bearings.

Newest bearing material, cemented tungsten-carbide, shows promise for high speeds, loads and temperatures. Recent tests had carbide running against carbide successfully at speeds up to 30,000 rpm and loads to 2000 psi.

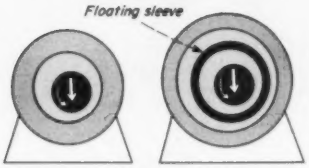
Porous Bearings. Powdered mixtures of various metals may be compressed into shape and sintered at temperatures below the melting point. Resulting structure is porous but strong. Porous bearings may be impregnated with a non-gumming lubricant or graphite may be used in the mixture, to give an essentially oil-less bearing. Or, bearings may be outside lubricated.

Graphited Bearings. As shown at left, graphite is combined with metal in some types of bearings. Carbon-graphite, molded and machined, forms bearings for service where temperature, material handled or location prohibits use of lubricants or makes maintenance difficult. Such bearings are self-lubricating, chemically inert and withstand high temperatures. They require hard, smooth journals.

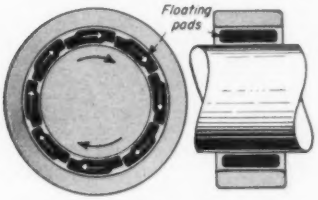
Non-Metallic Bearings. Wood bearings, impregnated with oil before installation, can also be used without outside lubricant. Lignum vitae is used dry or water lubricated. Wood expands with moisture gain, hence can be used only with large clearance. Where speeds, loads and temperatures are low, wood bearings stand up well to adverse conditions, need little attention.

Other non-metallic bearing materials include laminated-phenolics (water lubricated), molded plastics and nylon (unlubricated, or using oil or grease). Rubber bearings, usually lubricated with water or other low-viscosity fluid, serve well where sand or other hard

DOUBLE-FILM BEARINGS



FULL-FLOATING idea offers way to up oil flow without increasing clearance between adjacent mating surfaces. Aimed at high-speed applications where there is a tendency to overheating. Floating sleeve gives two paths, more oil flows



FLOATING PADS between shaft, bearing produce two hydrodynamic oil films, one on either side of pads. Shear stresses developed in oil cause pads to rotate. Soft metal on both sides of steel pads

particles can get into clearance space (propeller shafts for example).

Thrust Bearings. A rotating collar and stationary-pivoted or spring-supported shoes are vital parts of thrust bearings widely used in the power field. They run in a bath of oil (not under pressure). Oil drawn between collar and shoes forms a wedge-shaped film (see theory, p 82) having good load-carrying capacity. Wedge action is possible because shoes have some freedom of movement.

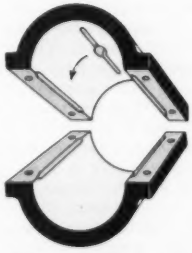
Oil films in thrust bearings are continually renewed by rotation in oil-flooded collar. Working shafts never touch as long as they keep turning. Since loads are concentrated and speeds are often high, oil heats because of internal friction. To remove this heat, oil is cooled by radiation or in an oil cooler. It is circulated either by automatic devices within the housing or by an outside pump.

Summary. It is only possible here to touch briefly on bearing construction and materials. For a quick roundup of materials and their characteristics, limitations and applications, see table above. A comprehensive discussion of bearings for internal-combustion engines appeared in POWER, Jan 1948, pp 84-87; Feb, pp 74-77.

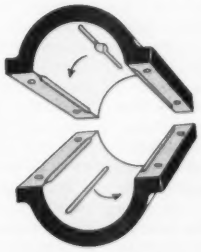
BEARING TYPES AND WHERE EACH IS USED

TYPE, MATERIAL	CHARACTERISTICS	LIMITS	APPLICATIONS
Bronze bushings	Low cost, simple construction	Shaft speeds to 900 fpm, loads to 3000 psi	All equipment
Porous bronze, iron, aluminum (oil-less)	Low cost, self-lubricating, quiet	Usual range 75-1500 fpm. Top pressure often 100 psi	Fractional hp, consumer products, controls
Heavy babbitt liner on steel or cast iron	Long life, low friction. Must have good lubrication	Steady loads, under 1000 psi	Motors, turbines, shafting
Light liner on steel or bronze backing	Heavy duty, general purpose. Good for dynamic loads	About 5000 psi and 4000 fpm	Gas and diesel engines, compressors
Rubber	Low friction, resists abrasion, shock absorbent, long life	About 80 psi. Needs water lubrication	Marine propellers, pumps, turbines
Molded plastic laminate (micarta)	Low friction. Stronger than babbitt when water lubricated	About 400 fpm and 2500 psi. Must be well cooled	Mill roll-necks, pumps, propellers
Molded plastic	Low friction, clean	Low loads if used at high speeds. Cool well	Dairy, textile, food machinery
Lignum vitae	High load capacity at high speed if water lubricated	Not over 2000 psi with water lubrication; keep under 200 F	Mill roll-necks, guide bearings
Wood (maple, lignum vitae)	Self-lubricating, low cost, long life, clean	Light loads at high speed. Under 150 F	Conveyors, machinery, conveyors
Carbon-graphite	No lubrication needed. Light-duty application	Under 850 F. 600 psi at low speeds, to 20,000 rpm at low psi	Electric motors, meters, conveyors
Cast iron	Low friction, low cost. Develops high glaze	Not over 500 psi and 130 fpm	Cam shafts, light transmissions
Steel	Low cost	Light loads. 150 fpm	Guides

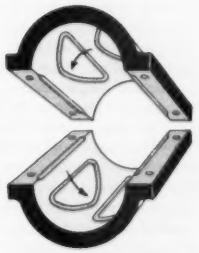
GROOVING DISTRIBUTES OIL, CUTS END LEAKAGE



SINGLE groove is often used in high-speed bearings. Oil flows groove's full length, is swept away by the turning shaft



DOUBLE groove may avoid heavy oil loss from bearing ends. Locate second groove 30-40 deg ahead of highest-pressure line



TRIANGLE design (rounded corners) may suit for low speed, heavy load. Base parallels journal, apex points with the rotation

IN GENERAL, use as little grooving as possible, especially in pressure areas

NO LOAD Rolling element between inner and outer races carries a film of lubricant into the pressure area. No parts deform

LOAD Lubricant is largely forced from pressure area. Bearing parts yield slightly. Yet lube at pressure-area edges supports some load

GUIDE TO ROLLING-CONTACT BEARINGS

Rolling friction being less than sliding friction, it's only natural that this principle should be applied to bearing design. The resulting *rolling-contact* bearings (often called "anti-friction") consist of rolling elements tucked between inner and outer races. They fall into two major classes — ball or roller bearings — differing in the shape of the rolling elements.

Big advantage of rolling-contact bearings lies in lower starting friction. But hydrostatic lubrication of sliding bearings cuts into this edge.

FRICTION is influenced by the quantity of lubricant

It's not easy to account accurately for the friction in a rolling bearing. In addition to rolling friction, there's internal friction of the lubricant. And there's some sliding friction too — especially between balls and retainers in deep-groove bearings and where the rollers have become skewed.

Studies show that rolling friction hinges on size of balls or rollers. The smaller these elements are, the higher the friction. Oddly enough, friction traced to churning up or pushing aside the lubricant, and pure hydrodynamic pressure, may be much greater than normal rolling friction of the bearing elements. Then why lubricate? For one thing, lubrication helps cut sliding friction. It also prevents seizure, carries away heat, helps sealing and protects against corrosion.

Since the power engineer isn't a bearing designer, let's step out of the lab now and take a look at how lubrication affects friction in a rolling-contact bearing. That's something you can exert some control over.

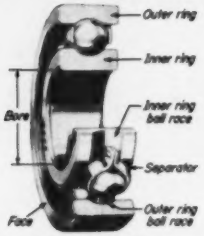
How Much Lubricant? How lubrication affects friction of a rolling-contact bearing depends on what kind of bearing we're talking about. Remember that *commercial* bearings are available, costing as little as 1/4 to 1/6 as much as the well-known *precision* type. These may be used for lighter loads and slower speeds. Lower cost comes from greater tolerances, lack of retainers or ball spacers, etc.

The research boys have found that a precision bearing will show slightly greater friction when lubricated than when dry. But just the opposite may be true of the low-cost type, where lubrication helps to cut the greater sliding friction at the start.

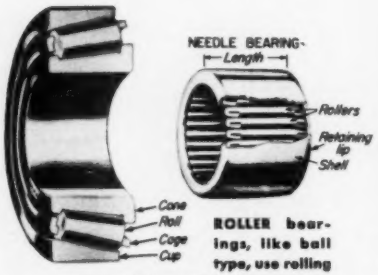
In either case, friction is lowest when but a thin film of oil covers contacting surfaces. Friction increases if either quantity or viscosity is increased. If friction were the only problem, all would be simple. But bearings show an energy loss proportional to product of torque and speed. This energy must be dissipated as heat, raising temperature of bearing and housing. And it also raises lubricant temperature, lowering its viscosity.

So we try to strike a balance between: (1) the desire to keep friction to a minimum, which means little lubricant and low viscosity, and (2) the desire to insure safe lubrication, which means more oil to help with cooling, and higher viscosity to avoid too much "thinning". The answer usually lies in using more than the minimum amount and higher than the minimum viscosity.

HOW ROLLING



BALL-BEARING race design determines if it can carry thrust load



ROLLER bearings, like ball type, use rolling contact. Rollers straight or tapered

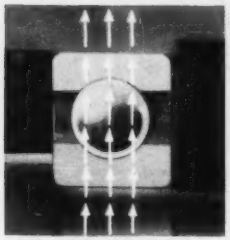
Practical Limits. That's the general line of approach. We can't be more specific here about viscosity, because it depends on too many factors. But we can get down to brass tacks on quantity. In the simple oil bath, for example, oil level at standstill should not be above center of lowermost ball or roller. In circulating oil systems, make sure points where oil enters and leaves are on opposite sides of bearing. Exit should be larger than entrance to prevent flooding or accumulation of too much lubricant. With grease, shoot for keeping housing about ⅓ to ½ full.

LUBRICATION: practical rules for applying oil or grease

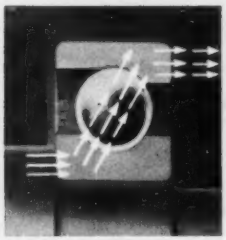
You can lubricate rolling-contact bearings with either oil or grease. Each has its place (see table next page). If you choose grease, there's no need for high-pressure equipment to apply it. Generally speaking, if you put in more grease than ⅓ to ½ bearing capacity it will be wasted and may cause bearing overheating.

But to be strictly practical, how can any lad running around with a grease gun tell when the bearing is less than

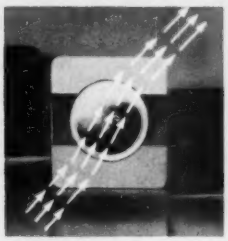
CONTACT CARRIES RADIAL, THRUST LOADS



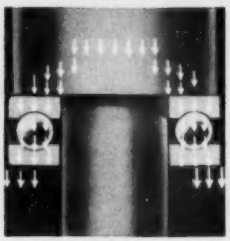
RADIAL LOAD
on race of deep-groove type



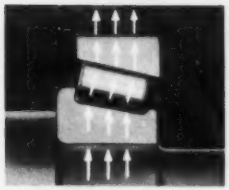
THRUST LOAD
on an angle-contact bearing



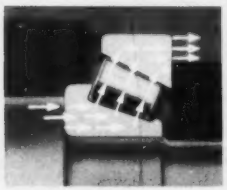
ANGULAR LOAD
on a deep-groove bearing



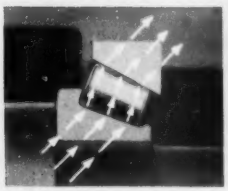
VERTICAL LOAD
on a thrust-type bearing



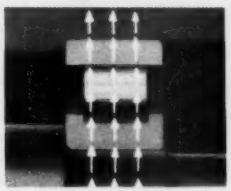
RADIAL LOAD
taken by a tapered roller



THRUST LOAD
on the same tapered roller



ANGULAR LOAD
goes on tapered roller, too



RADIAL LOAD
on straight-roller bearing

½ full? It's a cinch if the bearing is hand packed. Here's how: when greasing from a fitting in the housing, remove pressure-relief plug and add new grease while machine runs. Then replace plug after a few minutes. Machine operation forces out excess.

You'll meet cases where it's necessary to grease a bearing to more than the recommended ⅓ to ½ capacity. This comes about when speed is very low and bearing is exposed to excessive dirt or moisture. Under these conditions, pack nearly full.

PRE-LUBRICATED sealed bearings, now used in many electric motors, need no attention

Eliminating the chore of regreasing rolling-contact bearings is a natural step in making equipment relatively maintenance-free. Experiments with pre-lubricated bearings began many years ago, taking advantage of the small lubricant requirements of ball bearings. Manufacturers interested in this fundamental work devised seals and shields to confine needed quantity of grease inside a standard bearing.

Some makers successfully made seals inside the single-row bearing width and found that, although volume of grease became rather small, it was still enough for a long period of operation. European motor manufacturers have actually used such standard bearings in sealed housings with no provision for regreasing. In this country, thinking has favored use of a larger amount of grease. Following this line, and providing space for an efficient seal, has led to adoption of the standard double-row bearing width but a single row of balls.

Rated Same. Keep in mind that the pre-lubricated ball bearing does not differ fundamentally from the conventional open type. It is made from the same material, to the same specifications regarding tolerances and fits. It is rated to carry the same load and have the same life as its open twin.

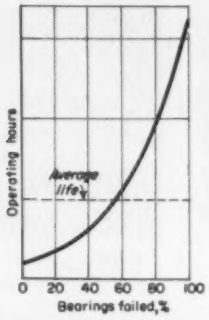
First major motor application of pre-lubricated bearings came in the textile field. Aim was to lick the tough problem of protecting grease fittings or oil cups from oil-thirsty lint that settles in heavy layers on any surface wetted by oil. Experience in this field was encouraging.

Grease vs Temperature. Type of grease used in pre-lube bearings depends on temperature conditions. Standard open motors are recommended for operation with bearing temperatures from −40 C to about 65 C (−40 to 150 F). This 65-C top temperature is a conservative value, not ultimate limit. This is especially so if high temperature is due to temporary or seasonal ambient conditions. Adverse effect of temperatures higher than recommended is gradual reduction in grease life. This life-shortening is stepped up as temperature increases.

Where bearing temperatures are in excess of 65 C, silicone grease is used — up to 100 C (212 F). For still higher temperatures — up to 125 C (257 F) — the bearings themselves must be heat-stabilized during manufacture.

Loss of Grease. The risk of losing the grease, and eventually the bearing, from grease leakage through seals is a point often raised. This has not been a problem even where the bearing operates in a high temperature which makes the grease more fluid. This can be understood by looking at the melting and dropping point of any good grade of commercial grease. These points usually run anywhere from 350 to 480 F.

A new pre-lube bearing will sometimes leak a little grease around the seals. This generally results from an



BEARING LIFE is operating hours 90% of bearings pile up before first signs of fatigue

COMPARATIVE ADVANTAGES OF GREASE AND OIL IN BEARINGS

Advantages of Grease

1 Maintenance may be reduced: no oil level to maintain, regreasing is infrequent

2 Proper grease quantity is easily confined in housing. Simplifies design of bearing enclosure

3 Freedom from leakage is important in food, textile and chemical industries

4 Improves efficiency of labyrinth enclosures, gives better bearing protection

Advantages of Oil

1 Oil is easier to drain and refill. This is important if lubricating intervals are close together

2 Use of oil makes it easier to control the correct amount of lubricant

3 Same lubricant may be used on other types of bearings on the same machine

4 If bearing must operate under high temperatures, conditions favor oil

excessive grease charge. Amount thrown off is very small and will not harm the motor.

Not all motor manufacturers agree on the use of pre-lubricated sealed bearings. Some feel the answer lies in designing a bearing housing that will hold a large grease supply and making provision for regreasing if and when necessary. Among plant engineers, some insist on pre-lube bearings for motors in out-of-the-way places where lubrication at best may be hit or miss. But they like the reassurance of being able to regrease motors that are in accessible places.

LIFE is usually determined by fatigue of bearing metal

In talking about sliding bearings, we said that if a full fluid film is kept, there is no bearing wear. In practice, even if a full film exists during running, it is missing while starting and stopping. That's when most wear occurs. Turning to rolling-contact bearings we find differences.

If a rolling-contact bearing is correctly mounted, lubricated and otherwise properly handled, all causes of damage are eliminated except one — fatigue of the metal. So life of an individual bearing may be defined as the number of revolutions, or operating hours at constant speed, sustained before first evidence of fatigue appears. Incidentally, fatigue may show up in either of the races or in the rolling elements.

Group Life. That's good enough for a single bearing. But when we test a group of identical bearings under the same conditions of load and speed, we find quite a spread in their life spans (see curve above).

If number of bearings in any test run is large enough, say at least 30, life span of the oldster rarely exceeds four times average. And about 10% of the bearings will show life spans less than 1/5 of the average.

Life Economics. Why all this fuss about bearing life? Well, it's a matter of economics. Remember, when a bearing fails in service you're out not only the price of a new bearing but the expense of dismantling and reassembly, plus the cost of downtime. So you'll want some measure of life when you select bearings for a given installation, particularly if they're hard to get at for replacement.

Average life might look like a good index of bearing quality. But, thinking in terms of *real* costs, many of the country's top-notch bearing men use another measure. They define *life* as *the number of millions of revolutions or hours operation at a given speed that 90% of the bearings in a group will complete or exceed before showing the first signs of fatigue failure.*

MAINTENANCE includes: lubrication, removal, cleaning and reinstallation

While you don't need to handle rolling-contact bearings like antique china, they do need proper care. They're precision made and this precision must be kept throughout their useful life.

Take certain precautions before installing a new bearing. First, make sure your hands are clean. Wash your hands but not the bearing. It has been pregreased by the maker. Press it in place on the shaft.

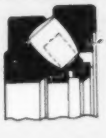
When inspecting an old bearing, look for excessively hardened areas. Streaks or spots are the give-away. Check for cracked parts, etching resulting from contact with acid, discolored areas caused by overheating. Any of these should cause rejection. For a complete picture-story on why ball bearings fail, see POWER, May 1951, p 116.

Bearing removal can best be done with a set of bearing pullers. They look and work like gear pullers. Apply pulling force on the inner ring that hugs the shaft. Don't tug on the outer race. Putting the bearings back on usually calls for a press and a pipe sleeve. After lining up the bearing, select a sleeve the diameter of the inner race. Put this sleeve between the inner race and the press. Apply even pressure and she'll slide home.

But installing some bearings may be tough work. It may call for heating the bearing in hot oil and using special equipment to raise and lower it. Heating inner race to between 200 and 250 F gives a good shrink fit. Sometimes it's more convenient to use dry ice and shrink the shaft. This allows the bearing to slide on easily.

A rolling-contact bearing properly installed and lubricated according to the maker's recommendations will give the service you expect. But if you slip up by skipping lube periods, using the wrong lubricant, letting dirt into the bearing, you'll run into a string of bearing failures. Bearings have no way of yelling for help if they don't get the right attention. They'll just sit tight and take it . . . until they fail.

TEN TYPES OF ROLLING-CONTACT BEARINGS OFTEN MET IN POWER WORK

	CHARACTERISTICS	APPLICATIONS
	SINGLE-ROW DEEP-GROOVE BALL BEARING Sustains radial load and substantial thrust, either way, even at high speeds. This ability results from intimate contact between balls, deep groove. Careful alignment essential	Electric motors, automobiles, conveyor rolls, aircraft-accessory drives
	DOUBLE-ROW BALL BEARING Grooves positioned so load lines through balls have outwardly converging contact angle. Has lower axial displacement than single-row, substantial thrust capacity in either direction, high radial capacity because of two rows of balls	Gear-reduction units, transmission shafts, starters, generators, auxiliary aircraft equipment
	ANGULAR-CONTACT BALL BEARING Supports heavy thrust in one direction, sometimes combined with moderate radial load. When sides are flush ground, can be mounted in tandem for constant thrust one way; in pairs face-to-face or back-to-back for combined loads	Worm drives, pumps, machine-tool spindles, centrifugals, superchargers
	SELF-ALIGNING BALL BEARING Adjusts misalignment from errors in mounting or shaft deflection, without capacity loss. Exerts no bending influence on shaft, essential for extreme accuracy at high speeds. Recommended for radial loads, moderate thrust either way	Woodworking machines, small hammer mills, fans, centrifugals, pillow blocks
	BALL THRUST BEARING For one-way thrust only. Load line through balls is parallel to shaft axis, resulting in high thrust capacity and minimum axial deflection. Flat seats on rings are preferred where load is heavy or close axial positioning of shaft is needed. Should not be used for high speeds under light loads	Crane hooks, machine-tool spindles
	SPHERICAL ROLLER BEARING Has unexcelled capacity. Inherently self-aligning. In addition to heavy radial loads, heavy thrust may be carried in either direction	Steel-mill equipment, crushers, fans, blowers, pumps, compressors, hammer mills, pillow blocks
	NEEDLE BEARING Carries heavy radial loads without taking up a large space radially. Since rollers cannot be flange guided this bearing has rather high friction and operates best when load is relieved at least once per revolution	Crankpins, wristpins, cam rollers, aircraft controls and landing gear
	CYLINDRICAL ROLLER BEARING High radial capacity. Provides accurate guiding of rollers, giving close approach to true rolling. Consequent low friction permits high-speed operation. Some types allow only limited free axial shaft movement. All easy to dismount	Traction motors, transmission shafts, machine-tool spindles, aircraft engines, gas turbines.
	SINGLE-ROW TAPERED ROLLER BEARING Carries heavy radial loads when opposed to another bearing taking induced thrust load. Also can carry heavy one-way thrust or combined load. Requires adjustment of internal clearance. Steep-angle type is for predominantly thrust load; multi-row types carry heavy loads in any direction	Automobiles, mine cars, steel-mill equipment, journal boxes, pumps, gear drives
	**SPHERICAL ROLLER-THRUST BEARING** Compact bearing for heavy thrust loads. Especially adaptable to such applications as worm drive, where minimum bearing centers are an advantage. Self aligning and capable of sustained high speeds at low operating temperatures	Steel-mill equipment, gyratory crushers, pumps, turntables, water turbines

TESTING THE LUBRICANT

PERFORMANCE The ultimate check on whether a lubricant is suitable calls for an "on the job" performance test. But this is seldom feasible because such a test takes a great deal of time and money. In addition there's the difficulty of controlling and duplicating widely varied operating conditions of the full range of machines. So if field testing alone were to be depended on, the progress of both lubricants and machines would be hampered. The answer is *simulated* performance testing in the laboratory as mentioned below.

PROPERTIES Once performance is proven, some yardsticks are needed to help maintain the lubricant's quality and to aid in purchasing. That's where an oil's chemical and physical properties come in. They are used to describe the oil and include viscosity, specific gravity, flash, fire and pour points, etc. Tests for these properties are just highlighted on the next two pages. For complete procedures refer to *ASTM Standards on Petroleum Products and Lubricants*. Also *Physical Properties of Lubricants*, published by the American Society of Lubrication Engineers.

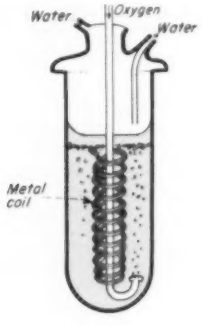
SPECIFICATIONS A specification is an exact description of an oil listing the numerical value of its chemical and physical properties. Specifications are essential to reproducing an item. But they're often expected to do more than they can. For example: an oil's pour point is often used to indicate whether it's suitable for refrigeration compressors. But this doesn't tell the whole story. Because even though the pour point may be way below temperatures met in service, *service conditions* can and do change the picture. In this case you can reasonably expect some mixing with the refrigerant. And with Freon-12, waxy products may precipitate to plug the expansion valve. So the answer is performance testing, *then* specifications.

PREDICTING PERFORMANCE

Like the modern power engineer selecting an assistant, the modern lubricant refiner weeds out the undesirable products by first putting them through simulated performance tests. Then he tries out his product by on-the-job tests. Through the use of the simulated performance tests, however, he is able to shorten the time involved in on-the-job testing.

Simulated performance tests used in the petroleum industry today are still in a state of change and improvement. Few have been standardized for industry-wide use. But like psychological tests now being used in employee-relations field, they've proven their worth in heading off wrong choices.

We're mentioning only two such tests; there are many more, including the Bower axle test, various specific engine tests, refrigeration-performance tests, etc. Any of the major oil companies can supply more information.

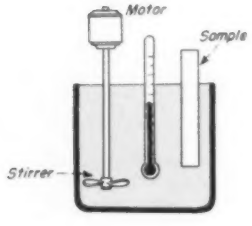


TURBINE-OIL STABILITY

Turbine oil must stand up under long periods of uninterrupted operation while exposed to air, water and catalytic effects of various metals, all at elevated temperatures. To do its job, turbine oil must resist premature oxidation, sludging and emulsification.

To simulate "aging", all known influences are brought into play and kept relatively constant throughout the test period. Sample is placed in a tube about 20 in. high. Distilled water, equal to about 20% of oil volume, is added to the oil. Tube is held in heated bath kept at about 200 F (below boiling point of water). This temperature, higher than met in practice, speeds up test. Various metals are introduced to check effect on oxidation rate.

After six weeks or so, samples are tested for acidity, sludging, rusting of coils, foaming, emulsification.



RUST PREVENTION

While the primary purpose of a lubricant is lubrication, rust prevention is an important secondary function.

Briefly, test usually consists of immersing a soft steel rod in a heated sample of the oil. After the rod is coated with oil, some distilled water is added. Test is run for about 48 hours; then the steel rod is examined for signs of rusting. Test conditions closely approximate actual turbine operating conditions. Rust prevention is also important with internal-combustion engines. Here, crankcase oil must protect the "innards", especially during long periods of standing idle.

MEASURING VISCOSITY

We introduced viscosity, back on page 81, as the physical property of an oil that offers internal resistance to motion. But to get a complete picture takes more than a straight description. Viscosity can actually be measured.

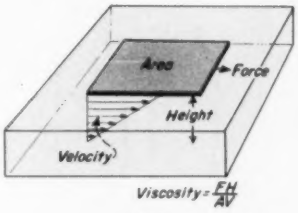
We can go back to Sir Isaac Newton (1642-1727) for the real starting point in viscosity measurement. He was the first to set up a formula for the force necessary to overcome viscous resistance of a fluid. Even though this work was done back in 1713, it was done so well that the relationships he established are still recognized and used as the basis for viscosity measurement.

Newton used two long concentric cylinders submerged in deep water. There was but little difference in the radii of the cylinders. The distance between the outer surface of the inner cylinder and the inner surface of the outer cylinder was the actual fluid-film thickness. Sir Isaac found the force needed to rotate one cylinder was directly proportional to *speed* and *area*, inversely proportional to film thickness.

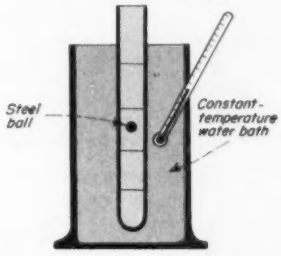
Same principle holds true if we separate two surfaces with a fluid film as shown in top right sketch. The fundamental equation $\mu = FH/AV$ is important since it defines the *dimensions* of viscosity. Since F is in pounds, dynes, etc., area A is distance squared, velocity V is distance divided by time and height H is distance, viscosity then has the dimensions of *force* multiplied by *time* and divided by *distance squared*.

In the English system of units dimensions would be pound-seconds per square inch. This unit is called the *Reyn*. In the metric or European system, viscosity would be dyne-seconds per square centimeter. This unit is called the *Poise*. Since the Poise is a rather large unit, the *centipoise* (1/100 of a Poise) is frequently used. To convert from one to another: number of Reyns equals $1.45 \div 10^7$ the number of centipoises.

So far we have been dealing only with *absolute viscosity*. This contrasts with *kinematic viscosity* where the density of the fluid plays a more important part. Below we discuss actual measurement of these two quantities.

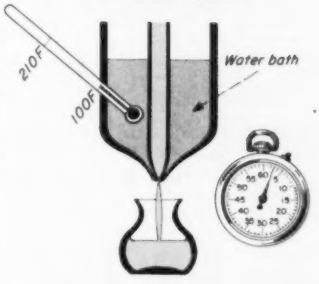


ABSOLUTE VISCOSITY can be measured several ways. Newton's original rig has been streamlined down to a cylinder suspended in a motor-driven cup. Another way uses the time required for a steel ball to fall through a measured height of oil. The equation is $\mu = K(D_b - D_l)t$. D_b is density of ball; D_l is density of liquid; K is a constant peculiar to the instrument; t is measured time for ball to pass two horizontal markings on glass tube. For example: time for a 0.15-cm-dia ball to fall 15 cm through a 2-cm-dia tube of castor oil at 68 F is 19.4 sec. This instrument is fine for oils having viscosity equal to castor oil (about 1000 centipoises) or greater at room temperature. For thinner oils, time of fall is too short for accurate work.



KINEMATIC VISCOSITY is more widely measured than absolute viscosity. It's actually the ratio of absolute viscosity to density of the oil at a given temperature. Unit of kinematic viscosity ν is the *stoke* (ν, stokes $= \mu$, poises $\div$ density, grams per cc). Reason density must be considered is that kinematic viscometers depend on oil flow under a head of oil, a function of density.

Most widely used viscometer in the U.S. is the Saybolt Universal Viscometer, shown simplified at right. In essence, it consists of a cylinder, holding the oil sample, with a short, small-diameter outlet tube closed by a cork stopper. Constant temperature bath surrounds cylinder. When oil sample reaches test temperature (usually 100, 130 or 210 F), cork is pulled. Then the time necessary for 60 cc of the oil to flow into a standard flask is noted. This time in seconds is the kinematic viscosity in Saybolt Seconds Universal (ssu). To convert to *centistokes*, $\nu = 0.22 \times ssu - (180/ssu)$.



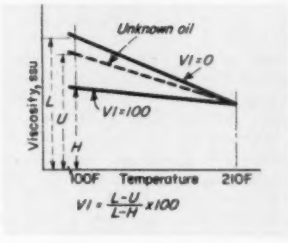
HOW VISCOSITY CHANGES WITH TEMPERATURE

Viscosity of lube oil drops as temperature rises. And it changes more in some oils than in others. There are many applications where this viscosity change with temperature is mighty important — diesel engines for one.

Here a high-viscosity oil on a cold start puts an extra burden on the starting equipment. Then as engine warms up viscosity drops. If it drops too much, wear or even seizure may result. So it's easy to see that a desirable oil would be one that changes but little with temperature.

Measurement of how much an oil's viscosity changes with temperature is its *viscosity index* (VI). Graph at right shows the formula. Values of L and H can be found in a table (ASTM D567 . . . too lengthy to reproduce here).

In determining viscosity, both starting and running temperatures must be considered. If viscosity changes too much, a VI "improver" may be needed.



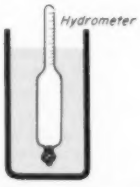
TESTING OTHER LUBE PROPERTIES

CARBON RESIDUE is measured after oil has evaporated. Suited for comparing used, new engine oils. Not a reliable index of carbon-forming tendency in lube oils

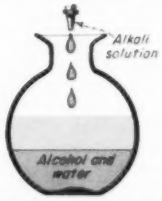
FLASH AND FIRE temperatures give lowest values oil will (1) give off enough vapors to ignite, (2) when ignited, continue to burn. Both indicate fire hazard involved

POUR POINT: lowest temperature oil will pour when chilled. Has some significance in low temperature work. Below this temp oil will not flow in gravity lube system

COLOR is expressed as a number based on comparing sample with standard disks. Important in textile industry. Also as index of uniformity for given grade



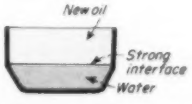
SPECIFIC GRAVITY: necessary to figure weight of any volume. Needed too when changing kinematic to absolute viscosity. Measured in deg API (Am. Petroleum Inst.)

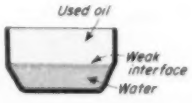


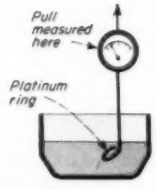
NEUTRALIZATION NUMBER is weight in milligrams potassium hydroxide (KOH) needed to neutralize one gram of oil. May tell when to change circulating oil (turbine)

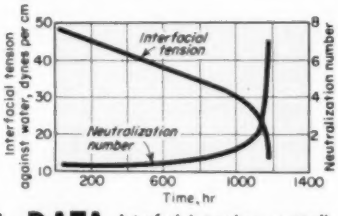
INTERFACIAL TENSION GAGES LIFE IN USED OILS

OILS OXIDIZE WITH AGE AND SERVICE. ACIDS FORMED LOWER THE SURFACE TENSION. THIS GIVES GOOD WARNING.









NEW Meeting point between oil and water (interface) is strong in new oil. Surface tension is high

USED Oxidized oil cuts surface tension of water; acids in oil tend to form a weak layer at interface

TEST Force needed to pull ring through interface will indicate surface tension between oil and water

DATA Interfacial tension, neutralization number both check on acid content. Some feel interfacial test gives more warning of trouble; used for checking new and used turbine oils

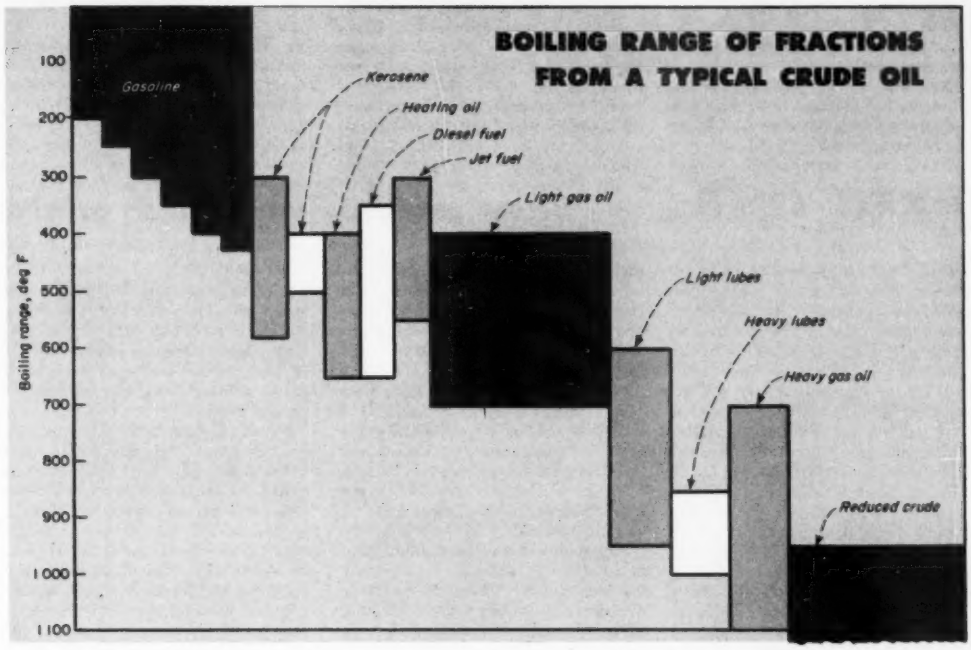
IMPORTANT GREASE PROPERTIES

Grease quality depends, among many factors, upon: oil and soap content and method of combining them into finished grease. Page 98 lists types of grease. Basic components may be combined so greases with same ingredients have different lubricating qualities.

Greases can be analyzed (ASTM D 128-47) to determine: fillers and ash, soap bases, soap, glycerine, fat, water, excess acid or alkali, etc. Tests at right are used to check greases proved suitable by performance testing.

PENETRATION NUMBER shows depth weighted cone sinks into sample. Grease usually "worked" before test. Low penetration means stiffer grease. Test tells how easy grease squeezes from bearing

DROPPING POINT is temperature at which grease passes from semisolid to liquid. It's often above safe operating temperature; distinguishes between conventional greases and those for high temp



FRACTIONAL DISTILLATION, above, is a separation process based on different boiling points of crude components. Fraction having the smallest number of carbon and hydrogen atoms has the lowest boiling point, specific gravity, and viscosity

FLUID LUBRICANTS

Fluid lubricants fall into three broad classes – *mineral oils, fixed oils,* and *synthetics* – depending on their source. Mineral oils are extracted from crude petroleum. Fixed oils are of animal or vegetable origin. Synthetics, as the name implies, are built rather than derived, some being hydrocarbons, others not. Each type is briefly discussed in the following three pages.

MINERAL OILS . . . stem from petroleum crude

So-called mineral lubricating oils are produced from crude petroleum, a natural fluid found in the earth. As it comes from the ground, crude oil is a complex mixture consisting of 83-87% carbon, 10-14% hydrogen, and oxygen, nitrogen and sulfur in small amounts or traces. Carbon and hydrogen atoms link up in more or less regular patterns to form *series*, which differ in the number of hydrogen atoms linked to a carbon atom and in the way the atoms are arranged. Typical series are *paraffins* and *naphthenes*.

As a general rule, the simpler hydrocarbon compounds are gases or "light" liquids and the more complex are "heavy" liquids or semisolids. Hydrocarbon compounds differ also in boiling point, making it possible to break petroleum down into groups of compounds by a precise form of distillation known as *fractionation*. This might be called the key step in *refining* – the process of converting crude oil into desired finished products.

When lubricant "stock" has been separated from other components of a crude it still needs quite a bit of finishing. Typical finishing steps include *dewaxing* to get rid of waxy compounds that become solids at low temperatures, and *filtration* to take out foreign matter. *Solvent refining* may be employed to remove resinous and asphaltic materials. And *blending* is usually practiced to produce the range of lubricant qualities desired by industry.

Many engineers have heard crudes referred to as "paraffinic" or "naphthenic." Such terms are not accurate but do serve to indicate the type of hydrocarbon compounds forming the main constituent. Thus Pennsylvania crudes are rich in paraffins; Gulf Coast

crudes in naphthenes. Crudes from the mid-continent region are often spoken of as "mixed-base," having both paraffins and naphthenes.

Generally speaking, paraffin-base oils show less change in viscosity with temperature variation than oils derived from other crudes. That's to say, they have a high viscosity index. Hence many specifications still call for paraffin-base lubes, even though cost may be higher.

Modern refining methods have, however, largely wiped out the distinction between crudes as far as the user is concerned. It's good practice to specify the viscosities at two temperatures (usually 100 and 210 F). Then allow some tolerance to cover slight differences among standard products of various oil suppliers.

FIXED OILS . . . have animal, vegetable origin

Fixed oils are animal or vegetable extracts. Animal oils are produced by heating fatty tissue. The family includes tallow, lard, neat's-foot, degras, whale, porpoise, dolphin and other fish oils. Vegetable oils come from seeds or fruits of plants or trees, and are extracted by pressing, or by chemical solvents. Among the vegetable oils are castor, rape, cottonseed, olive, coconut, palm, peanut, mustard and rosin.

Unlike mineral oils, fixed oils decompose on distillation. They also contain a high percentage of oxygen — from 10 to 15%. Fixed oils are rarely used directly as lubricants since they tend to oxidize into a varnish-like layer at temperatures where mineral oils remain stable. Their chief uses are in the manufacture of greases, and as a compounding agent in mineral oils.

Animal oils, like tallow, lard or degras, are often compounded with mineral oils for steam-cylinder lubrication. Tallow oil is obtained by pressing beef or mutton tallow, lard oil by pressing pig fat. Degras is made from the grease in sheep wool. Lard oil is used primarily as a cutting oil, and is added to some engine lubricants and stainless oils. All animal oils contain fatty acids and considerable oxygen in addition to the fundamental hydrogen and carbon.

Vegetable oils are chemically similar to animal oils, although they usually dry more readily. Castor oil, probably the best lubricant among them, comes from the castor shrub, and has the highest specific gravity and viscosity of any fixed oil. Castor oil is used in lubrication of engines having extremely high bearing pressures, such as heavy marine, experimental engines or machines, and racing-car engines. Castor oil does not mix well with mineral oil unless another fixed oil, like lard or rape, is present.

Rape oil — used in railway and marine-engine lubricants, soluble and quenching oils — is extracted from Indian and Russian rape seed. Cottonseed oil dries too readily to make a good lubricant, but it is sometimes used as an adulterant in other oils, and gives good "finish" for a cutting oil. Olive oil, formerly a nonstaining lubricant in wood processing, has now been mostly replaced by mineral oil. Linseed oil is not a lubricant.

SYNTHETICS . . . display high viscosity index

In recent years there has been widespread and justified interest in synthetic lubricants. Some present-day synthetics — although more costly — have properties superior to petroleum oils. Viscosity index is one such property. We can break these synthetics down into six general types: *polyalkylene glycols, silicones, diesters, organic chlorine compounds, polymer oils* and *voltol oils*. Of this group we can pick the polyalkylene glycols and the silicones as being typical.

Polyalkylene Glycols. Available in water-soluble and insoluble form, both over a wide viscosity range. These lubricants are of particular interest because of resistance to sludge and varnish formation, low solvent and swelling effect on various types of natural and synthetic rubber, low pour points, and good VI. Uses include lubrication of rubber and rubber-metal combinations, asbestos packings, metals in various forming operations, textile fibers, internal-combustion engines, gears, compressors, vacuum pumps, small electric motors, etc.

It might be added that the desirable characteristics mentioned above are inherent and do not depend on use of additives. Additives are used, however, when desirable to improve performance or modify properties.

One of the most interesting characteristics of these lubricants is their behavior when subjected to oxidation and heating. Products of oxidation and thermal decomposition of most polyalkylene glycols have physical properties similar to the original substance. This may account for resistance to sludge and varnish formation — and for relatively minor changes in viscosity after extended periods in internal-combustion engines. Polyalkylene glycols have been used as heat-transfer liquids for long periods at 425 to 500 F with no appreciable change in properties.

Like synthetics in general, polyalkylene glycols have wide high- and low-temperature applications. For example, they are used in the high-temperature range, with graphite, to lubricate bearing surfaces in industrial baking and drying ovens. On the low-temperature side, they are used for lubrication of pushrods on liquefied-hydrocarbon-gas pumps to prevent ice formation and increase the life of the packings.

Silicones. The basic elements are silicon and oxygen, and the silicone fluids fall into two main categories, let's say A and B, depending on operating temperature range.

Type A is a heat-stable, colorless to light-straw-colored fluid with viscosity of 100 to 150 centistokes, a generally flat viscosity-temperature slope, low volatility, and high oxidation resistance. Practical operating temperatures range from −40 to above 300 F. At present they are used on light to moderate loads.

Type B silicone fluid looks like type A but has a freezing point of −8 F and a flash point of 575 F. It is heat stable, and can be heated in contact with air at 500 F for over 1200 hours without jelling. One of its big characteristics is low volatility and generally excellent resistance to weather and oxidation. It is a good lubricant for temperatures from 10 to 500 F, and for medium to light loads between a ferrous bearing surface and a non-ferrous one such as zinc, chrome, cadmium, or phosphor bronze. It is also used as a high-temperature hydraulic fluid.

ADDITIVES . . . give oils additional properties

The general trend in industry is to put more and tougher loads on lube oils. To do the job, various chemicals or *additives* are often mixed with selected-base mineral oils to give the finished lube oil properties it does not inherently have. Typical additives are: anti-oxidants, detergents, viscosity-index improvers, oiliness agents, extreme-pressure compounds, pour-point depressants, and rust inhibitors.

Anti-oxidants. These can be subdivided into two general classes — the true oxidation inhibitor, and the catalytic poison. The true oxidation inhibitor simply deters oxygen reaction with oil. Catalytic poisons or metal deactivators neutralize catalytic action of iron, copper, etc.

Detergents. The aim of detergent additives is to maintain cleanliness in internal-combustion engines. In the crankcase zone, detergent action is purely physical; it keeps solid material suspended in oil. Up in the ring zone, the detergent keeps sludge or lacquer from plugging the ring grooves.

VI Improvers. VI additive is a colloid that raises the viscosity of the mineral oil in which it is dispersed. Resultant viscosity is then less affected by temperature change until temperature reaches the point where the colloid goes into true solution.

Oiliness, EP Agents. Oiliness or lubricity additives reduce coefficient of friction in *thin-film region*. They probably act through physical adsorption, see p 83. Extreme-pressure compounds generally contain sulphur, chlorine, or both. They form a chlorine-sulphur salt on the metal surface. This is helpful in minimizing the wearing effect of metal-to-metal contact. To take care of all possible conditions involving high and low speeds and high and low torques, it is often necessary to use an oiliness additive such as the fatty materials, along with conventional sulphur and chlorine EP compounds.

Pour-Point Depressants. When an oil containing dissolved wax is chilled, the wax crystallizes, which may prevent liquid flow. Pour-point depressants lower the temperature at which this crystallization occurs. You'll recall from discussion of physical properties that pour point of a given oil is temperature at which flow ceases under specified cooling conditions.

Rust Inhibitors. There are two classes of rust inhibitors. The first, used in circulating systems of turbines, is usually a polar-type material which by surface activity forms an adsorbed film on metal parts. This film prevents moisture from reaching the metal surface. Fatty acids are one example of such compounds.

The second type of rust inhibitor is used in engine oils where engine works in presence of heavy moisture or salt mists, or where bromides in leaded fuel are a factor. By chemical action a surface coating is formed on metal part to be protected.

Straight Mineral Oils, when used in turbine circulating systems, oxidize rapidly in some cases — thus the need for anti-oxidants and rust inhibitors in turbine oils. But straight mineral oils have been used in normal service where operating conditions are not severe. In such cases, the dissolved oxidation products act as rust inhibitors.

After a short period of operation, a good quality, straight mineral oil in a steam turbine may develop sufficient inhibitor action within itself to hinder rusting in the turbine oil system.

BLENDING . . . heavy, light oils for medium oil

A mineral oil, to which is added a fixed oil (animal or vegetable), is termed a *compounded oil*. Steam-cylinder and marine oils are good examples.

Blended Oils are mineral-oil mixtures of two or more fractions or cuts having different boiling ranges. For example: a medium viscosity oil prepared by mixing a light and a heavy (low- and high-viscosity) oil is a blended oil. *Many lubricating oils are blends.*

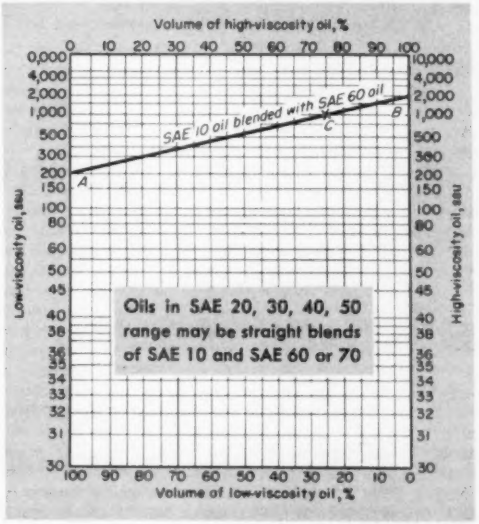
Blending is a refiner's problem. But the need for blending know-how sometimes crops up in the power plant if you have to mix oils of different viscosities. Here's how:

First off, in mixing oils it is assumed that both oils are alike in basic qualities and have the same additives. The difference is simply viscosity.

How much of each to use, to produce intermediate viscosities using say light, SAE 10, and heavy, SAE 60 or 70, can be estimated from the blending chart at right. This chart gives you viscosity of the mixture assuming the viscosity of components at one temperature is known.

To use, draw a straight line through the two points, *A* and *B*, representing viscosity of each oil at 100 F. The different proportions of each are read on the top and bottom percentage scales for a final desired blend of say 1000 ssu at 100 F. Such a 1000-ssu oil, point *C*, would require 25% of 200-ssu oil blended with 75% of 2000-ssu oil. Incidentally, it comes out SAE 40 grade. Other results are obtained by adjusting the quantities of blending oils.

Fuel dilution can be determined by a similar chart, (see POWER, August 1947, p. 85).



BLENDING medium-viscosity oil from high- and low-viscosity components. Point C above is SAE 40, blended from 10 and 60

GREASES

Grease is a semisolid combining a fluid lubricant with a thickening agent. Additives, fillers, etc, may be incorporated where necessary. Thumb back to p 90 for a list of natural advantages of grease in bearing lubrication.

There are many types of grease, some using petroleum lubricants, others synthetics. The general types used for average lubrication requirements fall into four groups.

These groups are: (1) water-resistant types, having *calcium* and *aluminum* bases, for applications anywhere from zero to 180 F, (2) water-soluble types, having a *soda base*, for operating temperatures above freezing to roughly 400 F, (3) multi-purpose, water-resistant types for both high- and low-temperature applications, and (4) types using synthetic fluids instead of natural mineral oils.

That's the over-all picture of commonly used greases, from the point of view of the lubricant user. Now let's take each and discuss it at greater length.

HOW GREASE WORKS

Older theory considered soap in grease as merely a storehouse for oil. Pressure squeezed oil out to lubricate bearing surfaces. This is probably only partly true.

Recent studies show soap molecules are adsorbed to metal surfaces with their long hydrocarbon chains sticking out from surface. Such layers are lubricants — they separate rubbing surfaces.

It's more probable that both soap and oil play a part in grease lubrication. With large clearances, oil may be most important. With close tolerances and high pressures, layers of soap molecules may take lead.

WATER-RESISTANT...usually for low temperature

Calcium-base grease is usually made by cooking tallow or fatty acids with lime and water. This forms the base or "soap." Next step adds definite amount of oil and water to get required emulsion of base and oil. Amount of oil added to base determines *body* or consistency of grease.

For example, a soft grease, say No. 1 in NLGI (National Lubricating Grease Institute) series, usually runs about 90% lube oil, a trace to 2% water, and the remainder soap. At other end of scale, about No. 5 NLGI, a stiff grease may run 25-30% soap, water to about 3% and balance lube oil. Oil viscosity can run anywhere from 35 ssu at 100 F to 5000 ssu or over.

Calcium-base greases are inherently for low-temperature use. At temperatures above 180 F, water in grease will evaporate. And since water acts as binder, oil separates readily, "bleeds" away from bearing. After oil bleeds out, heavy, sticky soap mass is left. This can cause trouble.

Aluminum-base greases show less tendency to bleed, are well suited for canning or textile equipment where bleeding would spoil product.

WATER-SOLUBLE...suitable for higher temperature

Like calcium type, soda-base greases are made from whole fats or fatty acids, water and lube oil. But caustic soda (sodium hydroxide) is used in place of lime. Manufacturing process is similar to that for calcium-base.

Big difference between calcium- and soda-base greases lies in fact that latter are more nearly a chemical mixture of soap and oil and don't depend entirely on water content to stay jelled. In soda-base greases, lower water content usually means a better product. Too much water causes grease to lose consistency.

Soda-base greases are inherently high-temperature greases. But they have been used in low ambients. For such use, oil viscosity and VI, along with type of fat, must be carefully chosen by grease maker. Even with low-vis oils, soda-base greases become stiff and difficult to pump when temperature drops below freezing. This means high starting torque. And it can prevent movement entirely in small rolling-contact bearings.

A final caution: soda-base greases are water-soluble so don't use them in contact with water or steam.

MULTI-PURPOSE... for wide temperature range

These greases are relative newcomers. Base is either barium or lithium. They're in the multi-purpose class because worked and unworked penetration runs about the same. (See grease testing, p 94.)

Barium-base grease has high resistance to water and a dropping point up about 400 F. It serves well at temperatures higher than 400 F if greasing periods are frequent enough to remove from the bearing the byproducts that form at the higher temperatures.

Lithium-base grease is similar in utility, with a dropping point over 350 F. But its low-temperature characteristics are far better. Water resistance of lithium-base grease isn't quite as good as barium-base; it falls somewhere between calcium and a good-grade soda-base grease. Ability to hold consistency on working, general resistance to water and suitability for high temperatures put it in multi-purpose class.

Growing trend toward use of multi-purpose greases stems from inherent good qualities plus need for reducing number of lubricants used in the plant.

SYNTHETICS... likely answers to tough problems

Synthetics are the newest development in the grease field. Many are made from standard soaps, with a synthetic lubricant substituting for mineral oil. And there are also the silicone greases — completely synthetic.

Synthetics are generally well suited for use at temperature extremes. They are produced in both water-soluble and insoluble types of many consistencies. In addition to their versatile temperature characteristics, most have little or no effect on natural or synthetic rubber.

Those specifically pitched for high-temperature use don't leave characteristic residual deposit found with most conventional greases at high temperatures. For synthetic fluids used, turn back to p 96.

Silicones are usually divided according to temperature of use. For instance, one silicone grease is suited for ball bearings anywhere from —100 to 300 F. A second type is good for temperatures from —20 to 450 F, and upward. When considering high-temperature applications, make sure bearing itself can withstand anticipated temperature.

Generally considered non-melting, silicone greases are highly resistant to water and oxidation, well suited for use in presence of chemical fumes. They are now being used to lubricate oven-conveyor bearings, low-speed oven machinery and pumps handling hot liquids. This is by no means a complete list of uses. They run the gamut in extreme-temperature work, even fitting into many pre-lubricated rolling-contact-bearing applications.

If you have a lube problem involving wide temperature variations, rapid oxidation, gumming, etc, look into the synthetics after thoroughly investigating the range of petroleum products. Synthetics usually cost more than conventional greases, but may be worth the difference.

Fillers. For want of a better spot, let's say a few words here about grease fillers. Such fillers as graphite, carbon black, mica, lead, zinc are among those used to give grease a "solid" body. They're often good for extreme loading and intermittent starting. Typical would be shock loads in steel-mill roll bearings, rubber mills, etc. Filler forms a solid film between shaft and bearing that isn't squeezed out during shock or shutdown.

SOLID LUBRICANTS

Some solid minerals, particularly graphite, mica, talc and soapstone have lubricating properties. So, also, do chemical compounds such as molybdenum disulphide. Space here is short, so let's call our shots and limit the discussion to *natural graphite, colloidal (electric-furnace) graphite and molybdenum disulphide.*

Natural Graphite. This is a black lustrous mineral, used as a lubricant either in dry form or mixed with oil or grease. It is, however, generally not suited as an oil-mix in ordinary lubricators or lube systems. It's heavy and settles to plug oil ducts or filters.

Natural graphite plus other materials serves as an electrical conductor and lubricant in motor brushes. It comes into play in manufacture of oil-less bearings; sometimes in paste form, solid rods, or combined with powdered metals. This is illustrated back on p 86. The better-quality graphites (those lowest in impurities) are generally selected for lubricants.

Colloidal Graphite. This is manufactured in an electric furnace from anthracite coal and petroleum coke. It is a soft greasy substance, almost chemically pure. Particle size is small, falling in the colloidal range. It is supplied commercially, mixed with distilled water, mineral lubricating oil, glycerine, varnish, etc.

The graphite family does a good job in the high-temperature range. When mixed with a liquid (for high temperature oven work as an example), liquid is merely a carrier to put the graphite where needed. Selection of vehicle hinges on anticipated temperatures.

MOLYBDENUM DISULPHIDE ...resists oxidation

In appearance, molybdenum disulphide, a chemical combination of molybdenum and sulphur, closely resembles graphite, has twice its density.

Basis of its lubricating action lies in a unique molecular structure. Each lamina of the compound is composed of a layer of molybdenum atoms flanked on either side with a skirt of sulphur atoms. Because of a strong metal-to-sulphur bond one of the sulphur layers hangs onto metal surfaces. Other side of the molecule slips easily over adjacent molecules because of a weak sulphur-to-sulphur bond.

Recent tests show molybdenum disulphide maintains its low coefficient of friction at high temperatures provided an effective subfilm of the product remains. Oxidation of molybdenum disulphide starts slowly at 750 F, continues steadily, becomes high at 1050 F. This product is finding use in machine-tool lubrication.

GRAPHITE FILMS...tough and resistant to abrasion

Within past few years a process has been developed for applying a tough film of natural graphite on finished surfaces. Compound used contains resins, metals and their salts plus natural graphite. Generally about 0.003-in. thick, the film is resistant to abrasion and exhibits good bearing strength.

Film can be applied by dipping or spraying. It is unaffected by weather, fuels, lubricants, water or dilute acids.

OIL DETERIORATION CAUSED BY CHANGES WITHIN

HIGH TEMPERATURES can "crack" petroleum oils, breaking down molecular structure. Carbonaceous and tarry products result. Oil also reacts with oxygen; resulting oxidation produces organic acids. Reaction goes faster as temperature rises. Metallic oxides usually present in lubrication systems may act as catalysts, further speeding reactions causing deterioration

WHAT HAPPENS TO OIL IN USE

In circulating systems, we use the same lubricant over and over again. How long will it last? A lot depends, of course, on how good an oil we start with. Let's assume it's top quality, what then?

In service, it's going to get contaminated — dust, metal particles, etc, will find their way into it. And exposure to oxygen, heat and other operating conditions causes changes in the oil itself.

How much harm outside contamination does depend largely on mechanical design of the equipment and what its condition is. Effect of exposure to heat and oxygen depends on severity of the conditions and on whether oil has been protected by additives which help to resist decomposition.

Finally, lubricant life can be extended by various conditioning devices which remove contamination and decomposition products, tend to restore oil to original condition.

To get a better idea of just what happens to oil in service, let's look at the lubrication of turbines and diesels.

LUBRICANTS IN TURBINE SERVICE

In the lubricating system of a modern turbine, a pump circulates oil rapidly. Passing through the bearings, oil heats to 130-150 F. It then goes on to the tank or reservoir. Before going back to the bearings again, oil flows through a cooler. In this round, oil meets up with most of the deteriorating factors illustrated above.

No. 1 problem is undoubtedly air, aided and abetted by water. Air may enter the system by leakage at pump suction or from the oil reservoir if level falls too low. Water gets in by leakage at shaft seals or in oil cooler. Or it may come from airborne moisture.

Oxidation of oil results from reaction with oxygen of air. How fast reaction goes depends on amount of contact between oil and air, presence of catalytic materials and, most important, temperature. Higher temperature means faster reaction. Products of reaction are organic acids.

Aeration of oil also causes formation of clusters of tiny bubbles, *foaming*. With water, *emulsification* results. Foaming and emulsification impair oil's lubricating value, lead to corrosion and may cause erratic governor operation.

Until about ten years ago, straight mineral oils were almost exclusively used for turbine lubrication. Today's conditions put greater demands on the lubricant, notably in the form of higher operating temperatures. Turbine oils thus usually contain anti-oxidants and rust inhibitors.

LUBRICANTS IN DIESEL SERVICE

The business of internal combustion in diesel engines brings additional lubrication problems — new sources of contamination, higher temperatures and pressures.

High temperatures, particularly in the piston-ring zone, cause petroleum oils to crack or break down in molecular structure. Carbonaceous and tarry products result. These play a part in ring-sticking and other troubles.

In the crankcase, where warm oil splashes about, oxidation occurs. Combination of oxygen and petroleum hydrocarbons forms organic acids of two general types: (1) volatile acids having low molecular weights and low boiling points, which are usually highly corrosive, and (2) acids having high molecular weights and boiling points, which are believed to take part in forming gums and lacquers.

Oxidation products lie at the root of a number of diesel lubrication problems. If allowed to become sufficiently concentrated, organic acids attack certain bearing metals, causing pitting and failure. Also they react with remaining oil to form sludges. Chemically, sludges are precipitated oxidized hydrocarbons. Deposits form in valve chambers, sumps, filters, oil coolers.

Reaction products are also blamed by some for varnish deposits on pistons, valve stems and other parts. These hard black films occur when oxidation products, soluble in oil up to a certain point, deposit on heated surfaces. On valve stems, varnish may cause sticking or burning. On pistons, it promotes ring-sticking.

Outside Contamination. Lubrication problems just out-

OIL ITSELF PLUS CONTAMINATION FROM OUTSIDE

DIRT

ABRASIVE action in bearings results from dirt that slips past air-intake filters, metal particles due to wear

WATER

WATER in lube may come from leakage past the seals in a turbine, form as result of combustion in diesel engines

FUEL

DILUTION by fuel and contamination by combustion products can be cut; insure free piston rings and replace when worn

AND WHAT TO DO ABOUT IT

lined result from changes that take place in oil itself, as a result of exposure to heat and air. Contamination from outside sources contributes to these problems and adds new ones. In the cylinder, for example, products of combustion — ash, carbon particles, unburned "heavy ends" of fuel, and water — mix with the lube oil. Ash and soot help to build up ring deposits. Unburned fuel may be cracked or oxidized in the high-temperature zone, making a resinous gummy material that forms a binder for soot or carbon particles.

Unburned fuel that finds its way past the rings and into the crankcase dilutes lube oil. For every gallon of fuel burned, about one gallon of water forms as a combustion product. This normally passes out exhaust as vapor, but some may condense, particularly on the lower parts of cylinder liners. This prevents proper wetting of surfaces by oil, and in combination with hydrogen sulfide or sulfur dioxide is a major contributor to corrosion and liner wear.

Water that reaches the crankcase may cause mayonnaise-like emulsions, which accumulate over screens and in circulatory system. Since water also tends to increase the activity of organic acids, it may accelerate corrosion of bearings and other parts.

Engine itself may form another source of contamination. Metallic oxides that accumulate in the lubricant act as powerful catalysts and hasten the oil's deterioration even though present in amounts as small as fractions of 1%.

Foreign Matter. Dirt and dust may enter cylinders through the air-intake system, particularly if filters are in poor shape. In addition, dirt and dust may enter the crankcase through the breather if it's not fully protected.

Under operating conditions the oil film lining cylinder walls is only microscopically thick. Thus even smallest dust particles have abrasive action. Further contamination may result from small metal particles off wearing surfaces.

Solving the Problem. Lubricating the diesel is, on the evidence, a tough assignment. Yet it's accomplished successfully. How? For one thing, refiners produce ever better lubricants. These are refined to have suitable physical characteristics, and even more important, desired chemical characteristics. Improved refining and use of inhibitors has increased resistance to oxidation. Still other additive compounds are used for detergent action. Such oils tend to keep oxidation products dispersed and suspended.

Time Factor. Much of development on improved diesel lubricants has aimed at solving the problems of the smaller, high-speed engines. Yet it should be clearly understood that exactly the same deteriorating factors are at work in large slow-speed engines. Because conditions are less severe, reactions are slower and they take place in a much larger body of oil. Hence effects show up much more slowly.

The operator plays his part in diesel lubrication by maintaining engines in good condition, thus reducing contamination by blowby, condensation and foreign matter. And he can, by adopting a sound program of lube-oil conditioning, remove decomposition and contamination products and maintain lubricant at or near original state of effectiveness.

OIL CONDITIONING

Various methods have been developed to remove contamination and decomposition products. These treatment methods may be applied in any one of three ways: (1) batch handling, (2) continuous total or full-flow handling, and (3) continuous bypass treatment.

In the first, entire oil charge is withdrawn and treated at one time for later replacement. With certain types of equipment and where rate of oil circulation is not rapid, the charge can be treated continuously as it circulates.

The most common method, especially in diesel plants, involves bypassing a portion of the circulating flow, say about 10%, to the treating equipment. Thus condition of a portion of the oil is being restored continuously. This brings total amount of impurities below danger level and avoids need for investing in large treatment facilities.

Although treatment equipment takes a wide variety of commercial forms, it can be reduced to basic principles. These are described in the two pages that follow.

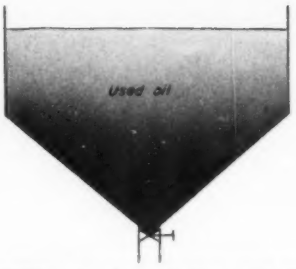
NOTE

Terminology in the oil-conditioning field is far from standardized. It isn't unusual for equipment of the same general type to be called variously a filter, a purifier, a reclaimer or a clarifier. Here we deal with principles and describe them as far as possible in common words. Remember that commercial devices often combine more than one principle, may be called by different names.

SETTLING

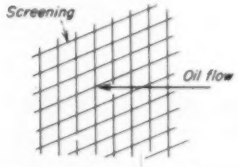
Sketch to right illustrates a simple batch settling tank. Here the heavier particles of sludge and dirt accumulate at the tank bottom. Water seeks an intermediate layer between heavy particles at bottom and clean oil on top. Preheating speeds the action.

Crude purifying equipment like this is often rigged by plant engineers. It can be sparked up a bit by welding three or four drain cocks and a sight gage to the sides of the tank to simplify removal of clean oil.

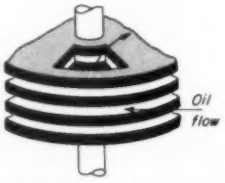


SOLIDS and water settle from used oil. Heating the oil to 180 F speeds results

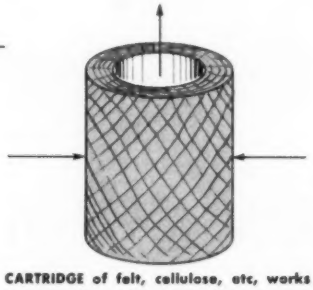
MECHANICAL BLOCKING



SCREEN stops solids larger than openings, and also some smaller than its mesh



EDGE filter uses metal disks separated by spacers. Rotating knives clean disks



CARTRIDGE of felt, cellulose, etc, works by entangling solids as oil flows through

A wide variety of devices remove *solids* from lubricating oils by some form of mechanical blocking. Most familiar method is screening or what is sometimes called *space* filtration.

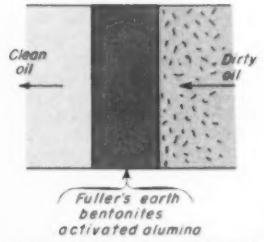
Space filtration provides a multitude of small openings (usually all same size) for the oil to flow through. Obviously, solids larger than the openings can't pass. And, if you remember trying to throw pebbles through a wire fence you'll recall that particles smaller than the openings often hit the mesh, and fail to get through. It's the same way with space filtration—some of even the smallest particles are stopped. The closer particle size gets to opening size, the higher the percentage that gets stopped.

Edge filter (*center, above*) employs same screening principle but different mechanical construction. Oil flows past edges of closely spaced metal disks and out through central openings. Rotating blades between disks make it possible to clean the device.

Depth filtration is another form of mechanical blocking. Filter element consists of loosely packed fibrous material such as cellulose fiber, felt, woven textiles, blotting paper, etc. Oil flows through relatively long and tortuous passages. Larger particles may be caught by screening action merely because openings on element surface aren't big enough. Most smaller particles will be carried into the tortuous passages until somewhere in the turns and twists they will impinge on a fibrous surface and be caught.

It should be remembered that pure *mechanical* action removes only *solids*.

ADSORPTION



OXIDATION PRODUCTS, and other soluble impurities, may be removed by adsorption

In *adsorption*, one substance attracts another and holds that material on its surface. It differs from absorption, which is ordinarily taken to mean an intermingling of one substance into the structure of another.

The mechanism of adsorption is not well defined. As applied in oil conditioning, it may be considered essentially electrical: surface of adsorbing material exhibits a specific attraction for molecules that are highly *polar* (containing unbalanced electrical forces due to unsymmetrical makeup).

Adsorbent substances are many: they range from natural materials like certain clays, through processed or "activated" materials, to synthetics like silica gel. Sketch lists typical oil-conditioning adsorbents.

Adsorptive conditioners will remove solid materials like the purely mechanical types discussed above. And, in addition, they remove dissolved acids and colloidal sludge particles by adsorption. Caution should be used in applying adsorptive filters for inhibited oils—some additives are removed.

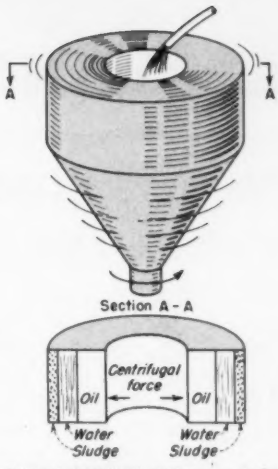
CENTRIFUGAL ACTION

Like basic settling process shown to left, *centrifuging* works by using difference in specific gravity between oil and impurities. Centrifugal action merely changes separation process from a vertical to a horizontal plane and speeds it up enormously.

In basic centrifuge sketched at right, a vertically mounted bowl rotates at high speed. Oil is usually warmed to make separation still easier. With bowl whirling rapidly, heavy impurities are thrown to outside of centrifuge. Here they're caught in sediment pockets and carried away. Water discharges through an intermediate spout while clean oil flows out by a third. Centrifugal action, many thousand times greater than gravity, insures removal of higher-specific-gravity impurities.

Naturally, a unit depending on centrifugal action will not separate liquids that are miscible (capable of being mixed). Thus it does not materially affect fuel-dilution in lube oils. Unlike many other filter types, capacity and efficiency of a centrifuge do not fall off as purification proceeds.

Applications. Centrifuges are used for both batch and continuous conditioning. By themselves they will effectively remove water, dust, dirt, coarse carbon particles, insoluble sludges and any other solid impurities differing in specific gravity from the oil. Centrifuges are frequently combined with an adsorptive conditioning unit which will take out the colloidal carbon products and organic acid constituents of soluble sludge.



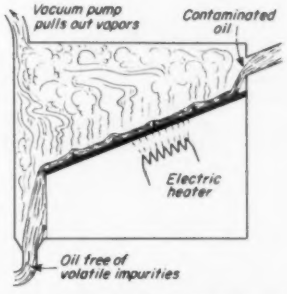
SPECIFIC-GRAVITY difference is basis of separation in centrifugal purifiers

VAPORIZATION

Complete conditioning of lubricating oil requires that soluble impurities be removed as well as insoluble ones. Vaporization is frequently employed for separating solubles such as fuel dilution. It is customary to operate under vacuum so impurities will evaporate at relatively low temperatures.

Operation. Oil drawn from a preheater tank is introduced into the vaporizing tank through a distributor head. It then flows by gravity over a tier of specially designed metal trays, arranged so a thin film of oil flows over entire surface of each tray. A series of electric heaters maintain oil at a predetermined temperature. As the oil flows over the trays, the volatile impurities evaporate and are drawn off from the main body of oil.

Such a vaporizer has a high flow rate. It can remove fuel dilution, water, or dissolved gases, from any straight mineral oil, compounded oil or synthetic lubricant. With its vacuum and rotary discharge pumps it is essentially self contained and needs no outside steam and water connections.



HEATED OIL yields volatile impurities readily when vacuum pump drops pressure

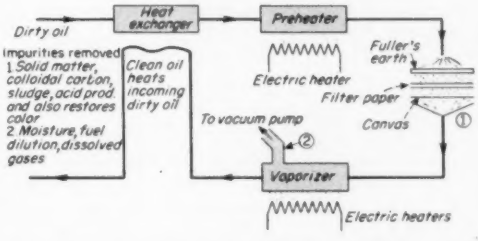
COMBINING METHODS

Since each basic method used in oil conditioning has some limitations, it is common practice to combine methods. We've already mentioned some combinations. Sketch at right shows another combination suitable for continuous operation. It employs adsorbent filtration to remove solids and acid products, gets volatile impurities by vaporization.

In the transportation field particularly, it is often desirable to reclaim crankcase oils on a batch basis at a central point. Processes used frequently represent a complete re-refining of the lubricant.

Typical setup might operate like this: Used lubricant is accumulated in large settling tanks, where some of heavy solids drop out. Oil is then heated and pumped into a mixing tank where activated clay (fullers' earth) is added. Clay and oil then go into a retort for heating under vacuum. Water and fuel contaminants are driven off and condensed.

Maximum temperature required in retort depends on type of fuel contamination. For diesel fuels a maximum of 525 to 575 F is needed. Lower temperature suffices for gasoline. Oil in retort is then "steam stripped". After temperature has been lowered, oil and clay drop into another tank where mix is chemically treated, agitated and pumped through a filter press to yield clean, re-refined oil.



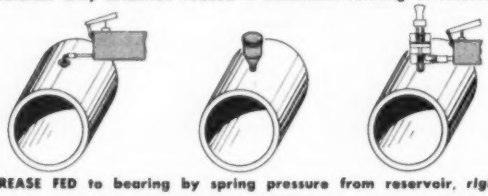
RE-REFINING of used oils can be handled by simply combining basic methods. Typical unit, above, is suited for plant use

Fortifying. If the oil originally carried additives, these may be removed in the re-refining process. The resulting clean oil must then be "fortified" — that is, suitable additives must be put in after the re-refining operation is completed.

APPLYING LUBRICANTS

TO THE SINGLE BEARING

OIL FEED from automatic oiler, *center*, is constant while machine operates. Only attention needed is occasional refilling of reservoir



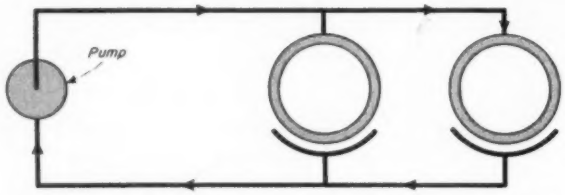
GREASE FED to bearing by spring pressure from reservoir, *right*. Spring compresses each time unit is filled from outside grease gun

The simplest and oldest method of lubricating the single bearing is the hand-operated oil can. At best, the oil can supplies in feast or famine fashion, not suitable for the critical needs of today's fast-moving, highly loaded machinery.

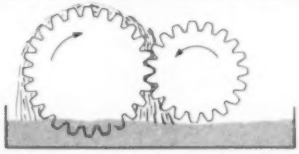
Feeding Devices. A step is made toward continuous supply of lube with the automatic oiler (wick-feed, gravity, etc) for individual bearings. And perhaps a closer approach is made with the ring-oiled bearing, *top right*. The ring picks up oil from pool beneath bearing and drags it through bearing slot; then moving shaft distributes oil between shaft and bearing. Once through, oil drops back into reservoir between bearing and housing.

Note similar evolution in the grease application picture: direct application with grease gun, grease cup, and finally the spring-operated grease applicator, *lower right*.

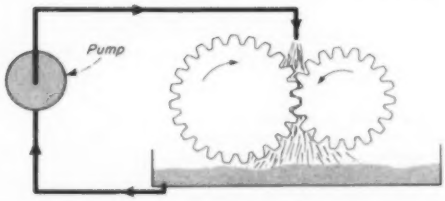
IN CIRCULATING SYSTEMS



EXTERNAL PUMP assures constant oil supply. After passing through bearings, the oil is collected and recirculated, reducing consumption



SPLASH LUBRICATION is simple form of circulating system (like a ring oiler). Oil is carried to pressure area by clinging on the teeth



FORCE FEED applies oil direct to the pressure area. Oil conditioning unit can be installed in the feed line to extend life of the lubricant

With the possible exception of the ring-oiler, above application methods are "once-through" systems. Large power equipment generally uses continuous oil circulation.

Advantages of a circulating system are: (1) adequate oil supply for both lubrication and cooling, (2) consumption cut by oil recirculation, (3) dirt removed by flushing action.

Sketches to left show elementary principles. In essence, an external pump forces oil through machine bearings, with provision made for collection and recirculation. Circulating oil systems are usually installed to handle more than one bearing or gear. Steam turbine is a typical case.

In turbine system oil acts as hydraulic medium for governor in addition to lubricating and cooling main bearings. Pump takes oil from reservoir, forces it through cooler, then into header. Branch lines run from header to individual bearings. Once through, oil flows back to reservoir. Strainer at tank intake removes larger dirt particles. In addition to simple strainer, some sort of oil conditioner is generally used to extend oil life and reduce bearing wear.

Since there is but one lubricant source, we can call the circulating setup a form of centralized lubrication. Today's usage, however, generally links centralized lubrication systems to once-through methods for lubricating many bearings from a common source . . . as we see on the following pages.

CENTRAL SYSTEMS METER AT SOURCE . . .

Gravity and force-feed lubricators, *right*, measure quantity of oil to be fed to each bearing. Both operate only when machine is running.

Gravity. Oiler unit must be mounted above highest point being lubricated. Oil flows from reservoir through individually adjusted valves, then through tubing to bearings. Refilling of reservoir, feed adjustment, start and stop of oil flow are concentrated at one point. Note the step toward eliminating the human element; all bearings are handled as one.

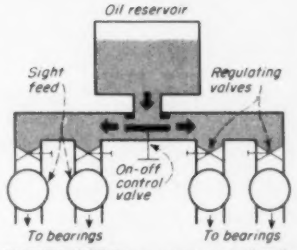
In some gravity units, the master valve can be controlled by a solenoid. Coil can be connected on load side of the machine's motor-starter. Then the oil starts flowing when the motor is energized. Likewise, flow stops when machine is shut down.

Force-feed lubricator, *lower right*, generally consists of a series of pumps with close-fitting pistons. Pumps are operated mechanically, usually by the machine being lubricated. One stroke of the piston creates a suction, filling the cylinder with oil. Return stroke forces this measured quantity of lubricant out through a feed line to the bearing.

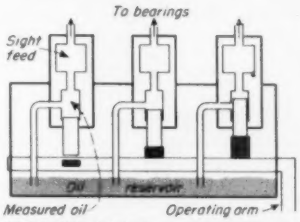
Note how the cams are arranged on the lubricator's drive shaft. In this way, the lube spurt can be timed to coincide with individual bearing needs. Many have hand pumps in addition. They fill the oil lines running to each bearing before the machine starts operating.

What viscosities can be handled? In general, any oil or grease that's fluid enough to flow to the pump's intake tube can be metered and pumped to a bearing. Where fluid flow is a problem because of low ambient, it may be wise to install electric strip heaters or steam heating lines in the lubricator reservoir.

Both gravity and force-feed units are typical of designs that measure and control flow of lubricant at the source. Now let's look over the fence . . . where the lubricant is measured at the bearing.



GRAVITY UNIT has master control valve operated by solenoid from motor starter



FORCE-FEED lubricator pumps measured quantity of lube at predetermined time

. . . OR DOLE OUT LUBE AT BEARINGS

Centralized systems that measure lubricant at the bearing are widely used on metal-forming machines such as presses, punches, etc. Many systems are available, all being refinements of setup shown schematically, *right*.

These systems combine a pump and a reservoir. Pump may be manually, electrically, or air-operated. Piping runs between reservoir and point of application. Systems operate with both oil or grease, with grease, perhaps, being the most popular. An indicator on each metering valve tells when lubricant is being supplied. Our schematic shows but one supply line running between reservoir and applicator. Systems are available that use two pressure lines running to these points to facilitate mechanical operation of injector.

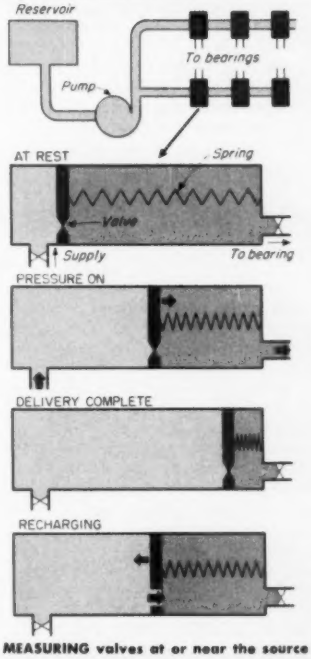
Let's consider some of the practical problems of installation.

Installation. If you're planning to install this type of system on existing machines, it stands to reason that you can't shut down your plant for six months to a year to do the job. So the first step is to take one machine at a time, let's say, in a group of twenty machines. Fit each machine with a circuit of metering valves similar to those shown at right. Metering valve for each bearing is connected to lube reservoir by flexible or rigid feed lines.

More practical plan may be to locate metering valves in groups of two to five at some convenient spot on machine. Select this spot so that it can be readily reached for any future maintenance. Then run lines from each metering valve to its bearing.

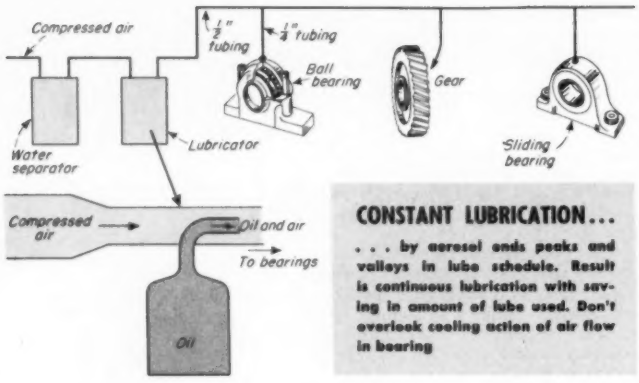
It may be advisable to use a hand-operated pump on each machine until entire group of machines can be hooked to the automatic supply unit. In this way, operator, with a few strokes of the pump handle, can cycle the lube system in a short time while machine is operating.

After basic circuits and metering valves are installed on all machines in the 20-machine zone, replace the hand-operated pump by an air- or motor-driven pump to supply lubricant automatically to *all machines in that zone*. Hand pump can then be used in the next zone selected for installation. A supply line from each machine in the zone connects into a header line. This terminates at the power-operated drum pump. Then all circuits on all machines in the zone are supplied from a single pump.



MEASURING valves at or near the source yield when the supply pressure is applied

MIXING OIL AND AIR



CONSTANT LUBRICATION...

. . . by aerosol ends peaks and valleys in lube schedule. Result is continuous lubrication with saving in amount of lube used. Don't overlook cooling action of air flow in bearing

LUBRICATING AEROSOL carries fine oil particles in suspension until they hit moving surface. Shaft movement drags oil from airborne mixture into the bearing surfaces

Use of airborne oil as a lubricating medium is an application of the *aerosol* idea. Such aerosol lube systems are generally fully automatic. They apply a uniform oil film to groups of bearings designed for either oil or grease. System can be used for plain or rolling-contact bearings, slides, rollers, chains or gears.

Aerosol lubricators atomize the oil, then distribute the oil-in-air mixture through tubing to bearing surfaces. Moving shaft in bearing actually knocks oil out of air stream, depositing it as a film between shaft and bearing. Oil separates from mixture only when it hits moving surfaces.

In operation, compressed air enters lubricator and picks up drops of oil fed into air stream. Heavy oil particles fall back into oil supply. Only very fine particles are pushed into lubricator discharge line. A portion of inlet air flows directly through lubricator without entering oil reservoir. This free air combines with airborne oil. In some cases, the oil feed in the lubricator is visible, giving a quick check on the rate of flow.

Oil-in-air delivered by lubricator has predetermined particle size. It's this small particle size that makes it possible to carry the fog long distances through piping without depositing. Hence position of lubricator in relation to bearings isn't critical. You can have uniform distribution to many bearings at the same time from one lubricator.

Capacity of aerosol systems is expressed in *bearing-inches* — sum of diameters of bearings to be served by one lubricator. Typical systems will handle up to 20 bearing-inches for plain bearings, 30 for ball or roller bearings.

Starting point on any installation is to tie down number and size of bearings to be served. Add to get bearing-inches. Then consider air supply. Select lubricator model best suited for your needs. Get maker's advice on final lubricator selection and tubing arrangement for the main and branch lines.

Advantages. Aerosol lubrication is *continuous* — there's a constant supply of uniform volume to each bearing. This wipes out feast-or-famine oiling. Aerosol systems are economical; it's not unusual to find consumption only one-tenth as much as for other "once-through" systems.

Air flow through bearings acts as a coolant. This ventilation, plus reduction in fluid friction, cuts bearing heat. And, as with systems shown on previous page, there's no need for attention other than for refilling lubricators as needed.

HOW CENTRALIZED LUBE PAYS OFF

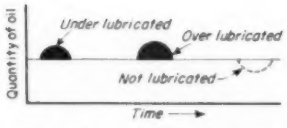
Centralized lube systems show many advantages. Most obvious is simply better lubrication—proper quantity delivered at proper time. And then there's the safety *angle*.

Safety engineers spot the lowly oiler as having one of the plant's most hazardous jobs. Many bearings require personal attention at least once every shift. That means oiler has to climb ladders or machine frame, often while unit operates, to turn a grease cup or direct a squirt of oil.

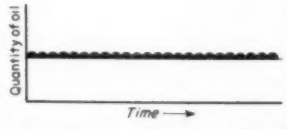
Centralized lubrication changes this picture by making the job automatic. On the cost side of the ledger consider savings in manhours when oiler is released for other work. And finally, lubricants are used economically.

Sketches at right compare hand oiling with a centralized system. As a basis for comparison, let's say bearing in both cases measures 3 in. in diameter and has a lube capacity of 0.058 oz. This 3-in. shaft spinning at 500 rpm revolves 240,000 times in 8 hr and travels the equivalent of 35.7 miles between oilings. If a feeding is missed, shaft travels more than 70 miles between oilings.

If same bearing is centrally lubricated every 15 min it makes only 7500 revolutions or 1.1 miles between feedings. Time between can be adjusted to insure a clean, adequate film of lubricant on bearing surfaces at all times. As operating conditions vary, both amount of lubricant and timing can be regulated as needed. And there are no missed feedings!



HAND OILING every 8 hr means bearing will need oil a major part of the time



CENTRALIZED system feeds bearing right amount every 15 min while machine runs

PLANNED LUBRICATION . . .

Years back, men who operated machines were often skilled mechanics who lubricated and maintained their own units. They may not have been lubrication experts but they did have a single-minded interest in keeping them going.

New Ways. As industry became larger and more specialized, maintenance tended to separate from operation. And, unfortunately, lubrication too often drifted off into an independent chore that got little real attention from anybody. "Oiling" became a low-skill low-pay job with little incentive. Today, lubrication engineers, relative newcomers to the professional field, are stepping into the picture. They're making lubrication an organized, scientific plant function.

Organizing. Best way to tackle the job of modernizing lubrication practice in your plant is to think of it as a separate function in the maintenance setup — not as an odd job to be done in spare time. Approach varies, depending on whether the lube group is being set up in a new plant or an existing one.

Start Early. In a new plant, the lubrication engineer in charge should work closely with designers, keeping them on the beam as to operation and maintenance. In this way, most-effective lubrication equipment can be installed at the start and the whole system coordinated for best working results. To maintain this good start, staff the lubrication group with trained men.

In an existing plant, you'll have to move step by step, but goal is the same — efficient, economical lubrication.

The whole job should be under the wing of the lubrication engineer in all cases. He should be responsible for: buying, storing, handling, applying and conditioning lubricants.

. . . calls for standardized lubricants

Big variety of lubricants used in many plants stems from rapid advances both in refining and in machine design. As new applications come along, refiners prepare new lubes. And machine builders take the stand that every new mechanism differs from others, needs a special lubricant.

Operator's Problem. You're not alone when you find recommendations in instruction books and on nameplates confusing. One machinery builder may recommend lubricant by brand name, another by viscosity at 100, 130 or 210 F. A third may specify by SAE (Society of Automotive Engineers) numbers, while a fourth uses AGMA (American Gear Mfrs Assn) numbers. It's easy to see there's a need for standardizing lubricant terminology as well as reducing the number in use. (Incidentally, to see relation between viscosity, SAE grade and AGMA number, see the POWER Handbook, July 1951, p 106.)

Surveying. If you're new at this business of plant lubrication, you'd be wise to call on the services offered by many, if not all, oil companies. They stand ready to send one of their trained lubrication engineers to work with you in surveying your plant's real needs.

Surveying involves studying each piece of equipment in your plant and determining the minimum number of lubricants needed for a good job. After the survey, set up a numbering system to identify each lubricant. Your own numbering system is preferable to using brand names.

The Payoff. If you've any doubts about whether reducing number of lubricants pays dividends, remember the plant where a survey turned up 900 drums and 80 different varieties of lubricants. Among them were a dozen barrels of elevator-guide grease — enough to run the plant's two elevators for years. Results of the survey: 80 types whittled down to 12; inventory cut to one-sixth original size.

. . . and standardized application

Standardization doesn't stop with lubricants. It's just as important to apply the same dollar-wise thinking to lubrication fittings, application devices and systems.

Try to adopt one standard type of grease fitting and do the same for oil cups. There isn't any practical reason for having a long list of different grease fittings, oil cups, wick feeders, etc., scattered over the various machines. Such a lack of standardization makes it necessary for lubrication men to use many different application devices and makes it easier to miss lube points.

Devices. While you are standardizing on fittings, think also of the application devices. A typical procedure might be to standardize on high- and low-pressure grease guns with portable filler pumps from which guns can be reloaded quickly and cleanly. Then there are power-operated transfer pumps to refill the filler pumps from the original refinery drums. In addition to cutting down number of kinds of equipment needed, the aim is to move lubricants from original containers to the bearings without getting dirt and grit in them.

Centralizing. After settling on fittings and application devices, take a look at the possibilities of centralized systems for machines with many lubrication points, or for groups of machines. Centralized systems help to eliminate the human element, make lubrication simpler and surer.

Ideal application of lubricants calls for some sort of mechanical control. The ultimate goal is getting the right lubricant to all bearings, in the right amount, at the right time.

FOR MORE ON PLANNED LUBRICATION, TURN PAGE ➡

LUBE NEEDS DIFFER WITH SERVICE

These properties are . . . important for . . .		unimportant for
Viscosity	Diesel oils	Spindle oils
Viscosity index	Winter motor oil	Industrial oils
Pour point	Refrigeration oils	Summer motor oils
Oxidation stability	Turbine oils	Cutting oil
EP properties	Gear lubes	Turbine oils
Flash point	Aviation oils	Hydraulic fluids
Rust prevention	Turbine oils	Gear lubes
Dielectric strength	Transformer oils	Motor oils
Color	Textile lubes	Steam-cylinder oils

BUYING . . .

Don't follow machine manufacturer's recommendations blindly. Make buying of specific lubricant a three-way proposition: machine builder, oil supplier and yourself. Your job is to furnish the info on operating conditions met in your plant

STORING . . .

Keep lubricants stored in separate oil room. Cleanliness applies right through from time lube container is tapped until ultimately used in bearings. To eliminate contamination use pumps to transfer lube from tanks or drums to applicator

The most practical approach to small-plant lubricant buying is to link results of standardizing survey (preceding page) to recommendations of machinery manufacturer. After deciding on specific lubricants, have supplier list properties of each type bought. This will simplify future buying.

In a large plant the task is often more rigorous. It is customary for the plant lubrication engineer to work up a specification sheet based on *past proven performance*. This would list desired viscosity, pour point, flash point, etc, based on standard ASTM test procedures. In addition, requirements for rusting, oxidation, interfacial tension, neutralization number, etc, are carefully outlined, and preferred methods of packaging and marking are indicated.

Many of the larger plants have their own test facilities to check samples of each lot of lubricant as received.

STORAGE

One common cause of lubricant "injury" is careless storage, which leads to contamination from dust, dirt, moisture, and other impurities. It is futile to insist on absolute purity from the supplier if that purity is destroyed afterward by haphazard handling and storing. Following is a list of rules that can eliminate storage troubles.

Where possible, store all lubricants in a clean, dry oil house that can be heated during cold weather. Don't store oil, and particularly grease drums, in actual contact with steam pipes, as overheating may change its physical characteristics.

Outdoor Storage. If space is tight, outdoor storage may be necessary. Confine products so stored to lower-quality grades intended for hand oiling, or oil-loss lubrication methods. Don't store turbine, diesel, transformer, or automotive oils in the open. Cold weather may cause separation of fatty oils from compounded oils. The same holds true for cutting oils containing fatty oils or other products with relatively high pour or dropping points. When you do store oil drums outside, place them on their sides on skids to prevent moisture from collecting on the heads. Where possible, shield from sun and weather by a shed or covering.

All lubricants are combustible, so keep all oil-soaked rags, grease, and other flammable material in fire-resistant containers. Place fire extinguishers at convenient points.

Tanks. Use sheet-iron or steel storage tanks. Don't use galvanized iron since the zinc may react with oils, especially if they are compounded. Number and size of tanks depends on volume and nature of lubricants to be stored. As a guide, put bulk-storage tanks in the basement, and use the main floor for receiving, delivery, and storage.

Have breather vents on all tanks. Since moisture and dirt will eventually accumulate in tanks, make sure there's a drain plug in the bottom of each. Run oil-removal pipes into tanks slightly above tank bottom. Then you'll always tap clean oil. Clean underground tanks with a suction pump about twice a year. Kerosene is a good solvent for small tanks.

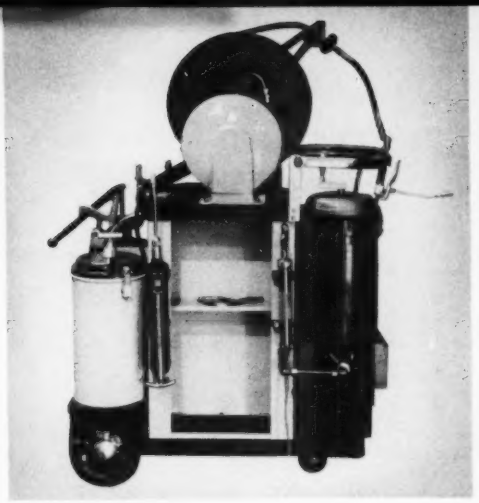
Wherever practical, use sealed measuring pumps, with filters and indicating meters, for pumping oils out of drums and tanks. Metering rig is a good addition since it also simplifies consumption recordkeeping.

HANDLING

A portable elevator or chain hoist, installed on a track over tanks, should be used to lift and guide drums into position for emptying into storage.

If you use compressed air to pump oil from drums to storage, be sure it is dry. Include safety valve to prevent building excess pressure that might spring drum seams.

Lubricants can be distributed depending on: (1) lubricant, (2) distance from storage to point of use, (3) availability of storage space, (4) and application methods.



TYPICAL MOTOR GREASING SCHEDULE

Oprg time, hr	Temp rise, deg C	Speed (if over 1800)	No grease fittings	Grease fittings, no relief plug*	Grease fittings, relief plug**
Int 8-16	All 40	All —	Repack every 4 yr	Grease yearly; repack every 3	Grease yearly; repack every 6
Cont 8-16 8-16	40 50-55 40	— — 3600	Repack every 3 yr	Grease yearly; repack every 4	Grease yearly; repack every 5
Cont Cont	50-55 40	— 3600	Repack every 2 yr	Grease at 6 mo; repack every 3	Grease yearly; repack every 4
Cont	50-55	3600	Repack yearly	Grease at 6 mo; repack every 2	Grease yearly; repack every 3

*Only 3 shots from gun when adding grease. **Remove relief plug and add grease until it shows clean at relief. Replace relief plug after running motor for at least 3 minutes. Repack only ⅓ to ½ full

HANDLING . . .

Reduce actual handling to minimum. Mobile lube cart above does just that. Motor-operated pump delivers grease under high pressure through 40-ft hose and control valve. Manually operated dispenser fills oil cans; another reloads grease guns

SCHEDULING . . .

The above motor-lubrication schedule has worked well in one plant. It may suit your needs now. But no good lube schedule is static. It must change as new and better lubricants and bearings are introduced. Flavor it with your own experience

Where small quantities of lubricant are handled, you can spot cabinet tanks at convenient points throughout the plant. A cabinet tank is simply a covered pump-drum combination.

If large quantities are used and machines are closely grouped, it is generally best to run pipe lines from storage to machines. On the other hand, if machines are scattered and distances great, a portable tank can be used.

Lube Cart. The portable lube rig shown above is used where a machine-service man (oiler) takes care of all lubrication. This modern version of yesteryear's oiler's cart incorporates an electric motor-operated pump to deliver light- to heavy-viscosity grease under high pressure to a 40-ft hose (with control valve) mounted on a self-retracting reel. The cart also has a manually operated gear oil dispenser for filling oil cans, plus an assortment of hand guns for specialized services. A filler-pump reloads hand guns. Equipment will vary on individual rigs depending on plant needs.

Basic rules for storing and handling oils and greases are: (1) keep lubes free from water and dirt, (2) keep them away from extremely high or low temperatures, (3) use same handling equipment for same products, (4) maintain general cleanliness in applying lubricants.

SCHEDULING

We can look at the scheduling part of the lubrication picture by simply injecting the time element: *when* the lubricant should be applied to each bearing, *when* the lubricant should be replaced and the housing flushed, *when* the filters should be changed, etc. Here we will only give a general guide, not specific recommendations.

Difficulty of giving specific recommendations is seen by glancing at schedule for motor lubrication, above right. Note that time between applications depends on specific operating conditions. Therefore, working up a suitable schedule calls for: (1) good working knowledge of each machine, and (2) knowledge of lubricants being used.

To drive this point home, let's once again consider the schedule shown above. This was not a one-shot operation. It was evolved, like other bits of practical knowledge, from studying the maintenance history (bearing trouble, condition of lubricant and bearing at each change, etc), then evaluating in light of existing time schedules. Many changes were made in this particular schedule over the years before it arrived at the form shown.

No schedule is static. It can't be with changes in lubricants, bearing designs, speeds, temperatures, and loads. But to keep any schedule you now have abreast of the times, get to know the new lubricants that are continually being developed. Get to know the ingredients, physical and chemical properties, results of performance tests, etc. Oil companies will do their share to give you this information.

ACKNOWLEDGMENTS

It is our custom to thank each manufacturer who cooperates in the preparation of our special sections. But in this, POWER's 81st, space does not permit more than a general acknowledgment of all the helpful basic data furnished.

We do, however, want to single out Dr. Dudley Fuller for a word of special thanks. As chairman of the Educational Committee of the American Society of Lubrication Engineers, Dr. Fuller reviewed the completed material for accuracy.

A McGraw-Hill Publication

Power

330 WEST 42ND STREET · NEW YORK 18 · NEW YORK

December 1, 1951

Mr. H. Carl Bauman
Chief Electrical Engineer
American Cyanamid Company
30 Rockefeller Plaza
New York 20, N. Y.

Dear Carl:

You and I were talking some time ago about what's ahead in the field of lubrication engineering. Working on our Handbook of Bearings and Lubrication reminded me of that conversation. It also gave me the idea that POWER readers might be interested in some personal "crystal gazing" of this kind. So here goes:

For one thing, it looks as if researchers in friction theory might come to closer agreement. My hunch is that they'll find the simple statement F = As, now often used to explain some sliding-bearing conditions (p 85), broad enough to cover sliding friction in general.

I think we can also expect current studies in "oiliness" and thin-film lubrication to unveil new additives and hence new lubricants tagged for the boundary region. We'll see many more applications of hydrostatic lubrication. And machine designers will continue to specify oilless types for light loads where they know bearings won't get lubricated once they've left the factory.

Pre-lubricated sealed-for-life rolling-contact bearings will find wider application as life of both bearings and lubricants is extended. This life angle is important. It is one of the reasons power-plant operators shy away from rolling-contact bearings for auxiliary drives. The strongly entrenched sliding bearings have given longer and more dependable service in this field.

It seems to me that accelerated performance testing will get a bigger play as temperatures, speeds and loads increase. Synthetics will show a healthy growth in certain fields – mainly for those applications where petroleum products leave something to be desired.

Lubricant service life will be extended, not only because of improved refining techniques and new additives, but also because: (1) lubrication will get more consideration in machine design, and (2) oil-conditioning methods will continue to improve and will find wider application. Centralized lubrication (particularly the aerosol method) will make further strides.

And, finally, fundamental significance attaches to the growing importance of the lubrication engineer in the industrial picture. Smart management welcomes planned lubrication as a long-overlooked practical means for getting greater productivity at lower cost.

Sincerely yours,

James J. O'Connor
Associate Editor

Will Defense Production Be Caught in the Squeeze?

When Congress revised and extended the Defense Production Act, it relaxed a squeeze on business profits.

President Truman asserted that this action by Congress cripples the government in its effort to prevent inflation which, as he puts it, could lead to "enrichment and profiteering for the few, economic hardship and misery for the many."

He asked Congress to rescind its action.

This editorial—the second on problems presented by "escalator"clauses—aims to throw some light on this conflict of opinion.

The Squeeze

The squeeze on profits was imposed in the name of price stabilization. The idea behind it was simple. The *selling prices* of industrial products were to be held under a tight lid. But many industrial costs are affected by "escalator" clauses of one kind or another which tend to boost production *costs*. Thus, with rising costs and fixed prices, profits would be squeezed and much of the cost of defense would thereby be shifted from those favored by escalator clauses to business concerns.

The mechanics of this squeeze on profits were complicated. But here, in brief, is how it was to work. The first step was to require manufacturers to set ceiling prices, effective May 28, for their products.

These ceiling or maximum prices were to allow for increases in manufacturers' costs that had occurred since Korea. *But they did not allow for all increases.* Manufacturers, for example, could not include increases in indirect costs—office or selling costs. Neither could they, in calculating their new prices, include increases in the costs of materials or direct labor that had come after March 15. This was the first phase of the squeeze on profits.

The second phase was prepared by **not** putting a ceiling on costs. The Wage Stabilization Board said it could not disturb the operation of "escalator" clauses by which wage rates are geared to the cost of living. Moreover, nothing could be done to curb the operation of the farmers' "escalator" clause, the farm parity arrangement. Under it, the federal government underwrites higher prices for farm products to match increases in the cost of things farmers buy. So this left wages and many materials costs free to rise against a ceiling imposed on the prices of what industry has to sell.

Relief—at a Loss

On two conditions only would the Office of Price Stabilization permit a company to raise its prices and escape this squeeze. One of these was that increased costs had more than wiped out its profits; in other words, that it was operating at a loss. The other condition was

that the industry of which the company is a part was not, as a whole, making "excess profits." That is, the industry, as a whole, could not get price relief if its overall profits before taxes were greater than 85 percent of its average profits during the best three of the four years from 1946 through 1949. Many companies expected that their profits would be cut drastically before they could get through this narrow escape hatch.

When this squeeze on profits was set up, we were told that industry as a whole was reporting record profits. But, it was equally true that wage rates and farm prices also were at record high levels. And it was also true that, under the impact of rising taxes and the dislocations caused by the defense mobilization program, profits actually were on the way down.

Profits — Going Down

By the time Congress acted to relax the squeeze, corporate profits, after taxes, were running at a rate 20 percent lower than they had been six months before. And the clear prospect was that they would continue to decline.

So the issue put up to Congress was simply this. Should business firms stand so much of the brunt of the defense costs while "escalator" clauses continued to exempt organized workers and farmers from paying their share of those costs?

But this question actually is much broader than one of fairness or unfairness alone. One certain effect of such a squeeze on profits would be to undercut the capacity of private industry to install the new plants and equipment needed for our mobilization effort. Today — unlike World War II — private industry is financing almost all of our huge program to expand production. And about two-thirds of the money that has been plowed into the expansion and improvement of our industrial machine since World War II has come out of profits.

In view of all this, Congress decided last summer to relax the pressure on profits. This was done by the controversial Capehart Amendment to the Defense Production Act. This amendment has serious administrative weaknesses. But some measure with the same purpose is needed to maintain profits at a high enough level to finance the huge and continuing expansion of our industrial machine that is now underway.

Basic Issues

As soon as the amendment was enacted, the President asked Congress to revise the law again. The heart of his proposal was to restore to the Administration the powers it used last spring to arrange the squeeze on profits outlined here.

This controversy will continue. There can be no final answer to it as long as we have the economic controls made necessary by mobilization.

But if we look beneath the surface of this technically complicated controversy, we shall see clearly that the basic issues are:

1. Whether we really shall make an effort to distribute fairly the burdens of inflation caused by our defense mobilization —

2. Whether farmers and organized workers should be exempted from these sacrifices by escalator clauses — at the expense of the nation as a whole —

3. Whether profits should be squeezed still more — at the risk of putting a fatal squeeze on the effort of industry to build new plants and install new tools. These new facilities are essential to maintaining American living standards — and they are the heart of our ability to defend ourselves and the rest of the free world.

Americans face no more important economic issues at this time.

McGraw-Hill Publishing Company, Inc.

DEFENSE DIGEST

Your roundup of mobilization news and trends affecting power men

Guns-AND-butter honeymoon...

... may be coming to an end. Those who believe in being tough with the civilian economy claim we're running the risk of falling behind in the arms race. The military wants a bigger share of materials. Pressure is welling up from the real sufferers under the guns-and-butter philosophy – makers of industrial equipment. They've been in the middle most of the time, and haven't liked it. Some observers saw signs of a shift to tougher policy in the '52 first-quarter allotments. Watch for future cuts, they say.

Guide to defense agencies...

... has just been published by General Services Administration. Called "Handbook of Emergency Defense Activities," it lists names, addresses and telephone numbers – 125 pp worth for $0.30. Send to Supt. of Documents, Government Printing Office, Washington 25, D.C.

Iranian oil agreement...

... is being whittled out behind closed doors in Washington as this is written. Unless all portents are wrong, Iranian oil will flow West again. But, don't forget, it'll take time to re-align emergency-shifted production and transportation schedules. So, Iranian oil won't play part in this winter's supply.

Even without Abadan's products, picture here isn't too bad. It was figured we'd have to shoulder a 460,000-bbl-per-day deficit. But stepped-up foreign production cut our share to 260,000 bbl per day for the last quarter of '51. This easing, and fact that stocks of crude are rising, caused Texas and Louisiana to cut back allowable production. Petroleum Administration for Defense thinks this move premature, hopes it won't hurt when winter peak hits.

Pipelines getting nod...

... in form of steel allotments total 10,500 miles in 24 major projects. All but one are scheduled for completion by end of third quarter, 1952. They include: (1) Gas lines from Gulf Coast to Chicago, and from Mississippi to Connellsville, Pa. (2) Oil lines from Borger, Texas to Chicago, from Wood River, Ill. to Chicago and Detroit, and from Wyoming to Wood River.

Aluminum for everybody...

... by 1953 should be a safe bet, with most of the industry's 100% capacity increase due to come in second half of 1952. But until about mid-1952, the going will be rough. There's a possibility government may decide to forego its first-quarter quota for the stockpile, as it did when the tight Pacific Northwest power situation forced shutdown of some aluminum production.

Tin users warned...

... that stalled price negotiations with foreign producers may cause clamp-down on consumption to protect the stockpile. This hits the bearing field, because tin's alter ego, lead, is currently one of the tightest of metals.

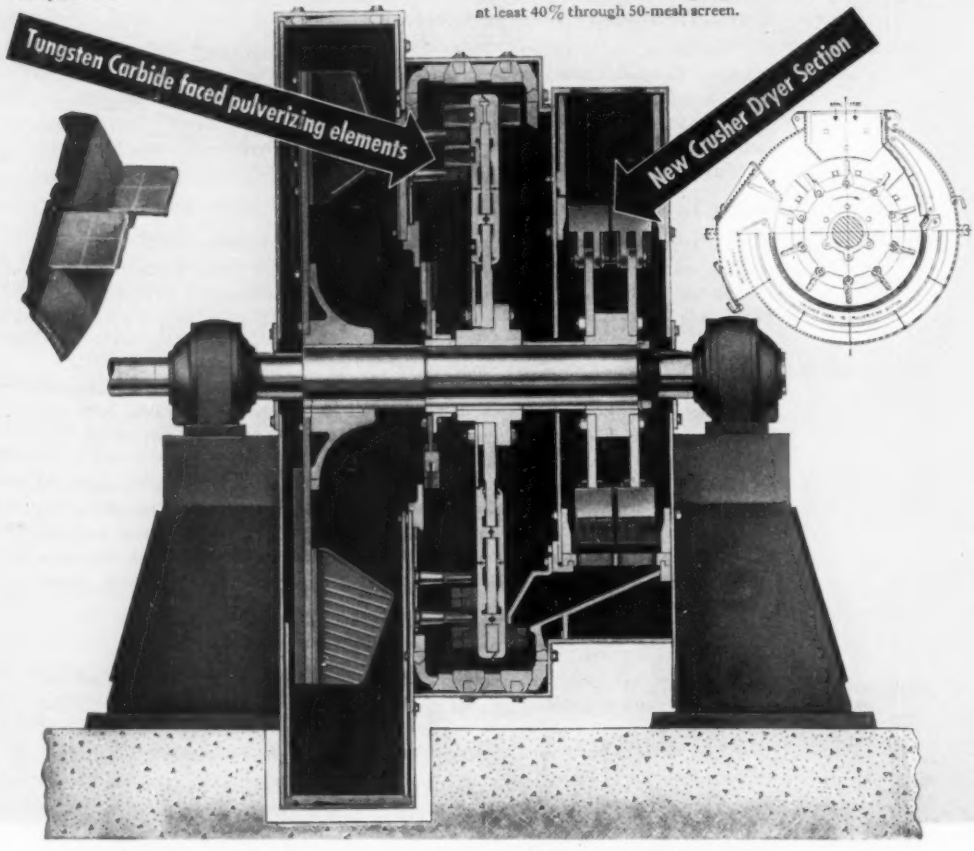
Don't forget copper scrap...

... in the midst of heavy emphasis on steel scrap. To assure continued production of copper and copper-base alloys, it's urgent that all utilities and industrial organizations locate and sell at once all discoverable copper and copper-base-alloy scrap. Start looking now!

The New "RILEY 50" Pulverizer

Gives long uninterrupted operation, low maintenance and sustained fineness over years of operation.

Where the free moisture is evaporated—no capacity reduction with high moisture—where foreign materials in coal are rejected. This section reduces the coal going to main pulverizing section to at least 40% through 50-mesh screen.



We can merely touch on the many operating advantages of the new Riley "50" pulverizer in a two-page ad. The Riley "50" is the most significant pulverizer development in the past decade. Write for the story of the Riley "50." It will pay you to thoroughly investigate the Riley "50" before purchasing coal pulverizers.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Atlanta · New Orleans · St. Louis · Kansas City · St. Paul · Tulsa · Houston · Denver
Salt Lake City · Los Angeles · Portland · Seattle

BOILERS · PULVERIZERS · BURNERS · STOKERS · SUPERHEATERS · FLUE GAS SCRUBBERS

Spontaneously Accepted by Engineers

Because of These Outstanding Features

*1 No capacity reduction with increase in moisture.

2 Tramp iron, iron pyrites and other foreign materials in coal rejected.

*3 Pulverizing elements faced with tungsten carbide.

4 Fineness sustained over years of operation.

5 Long periods of operation without necessity of shutdowns.

*6 Unusually high capacity per unit of space.

*7 Minimum foundation requirements.

*8 Ability to carry low loads.

9 Flexibility-wide load range.

*10 Operates without coal, with no noise and without wear or damage to parts.

11 Low maintenance and power.

*12 No explosion hazard, travel of coal through pulverizer faster than flame propagation.

*13 Quiet vibrationless operation.

*14 Ease of lighting and regulation.

15 High primary air temperatures.

16 Thoroughly dependable.

*17 Negligible cost of lubrication.

*18 All moving parts on a single horizontal shaft with bearings outside of housing. No worms or gears.

*19 Primary air fan integral with pulverizer —separate fan and motor not required.

**No other pulverizer can approach the Riley "50" in these important characteristics.*

All of these companies have ordered Riley "50" Series pulverizers within the past year

Public Utilities

*Monongahela Power Co.
*Iowa Electric Light & Power Co.
Utah Power & Light Co.
*Northern States Power Co.
*The Potomac Edison Co.
*Superior Water, Light & Power Co.
Central Ohio Light & Power Co.
*City of Owensboro, Ky.
City of Austin, Minn.
*Corn Belt Power Co-operative
*Public Service Co. of Colorado
Hartford Electric Light Co.

Industrial Plants

St. Croix Paper Co.
Hooker Electrochemical Co.
*Pittsburgh Plate Glass Co.
Celanese Corp. of America
United States Steel Co.
*Western Electric Co.
*Continental Can Co.
Monsanto Chemical Co.
Northern Paper Mills
Bell Aircraft Corp.
Syracuse University
Riegel Textile Corp.
Owens Corning Fibreglas Co.
*U.S. Finishing Co.
*Ciba States, Ltd.
*East Newark Realty
Lawless Brothers Paper Co.

**These companies have never previously used Riley pulverizers. The other companies have repeatedly ordered Riley pulverizers.*

These contracts were engineered by the following consultants

Bechtel Corporation
Ebasco Services
Chas. T. Main, Inc.
Pioneer Service & Engineering Co.
Sargent & Lundy
Sanderson & Porter
Stone & Webster Engineering Corp.
Black & Veatch
United Engineers & Constructors
Stanley Engineering Co.
Kenneth R. Warrington
J. V. Edeskuty
Francisco & Jacobus
Douglas M. McBean
Robson & Woese, Inc.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

best
. . . FOR OUTDOORS

● Steam Trapping presents special problems when the condensate cannot be returned to the boiler but is wasted.

Ordinary steam traps then cause much heat loss by discharging condensate at high temperature.

If the equipment is outdoors, there is the further problem of preventing freeze-ups in winter.

On board ship the presence of severe vibration further limits the choice.

ALL THESE DIFFICULTIES CAN BE OVERCOME, BY INSTALLING

SARCO LIQUID EXPANSION STEAM TRAPS NO. 871

This trap discharges condensate to atmosphere at below 212°F regardless of inlet pressure (up to 350 psi). When cold, its large discharge valve is wide open. No special protection against freezing is needed.

AFLOAT use No. 871 on heating coils of tankers and liquid cargo carriers; also to assure dry steam to whistles, winches and other deck machinery.

ASHORE use No. 871 on docks, piers and in railroad yards and terminals; also on outdoor storage tanks and tracer lines or pipe line heaters.

Full details in new bulletin *No. 260.*

NOTE: A special model is available to protect mechanical traps against freezing. It can be set as low as 40°F. Ask for drawing S-1350 on Sarco Thermic Drain.

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N.Y.
SARCO CANADA LTD., TORONTO 5, ONTARIO
Branches in Principal Cities

350

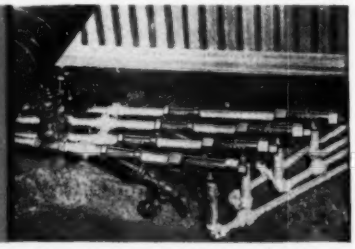
Only Sarco makes Liquid Expansion Traps which use the uniform force of oil expansion to operate a single seated valve of stainless steel.

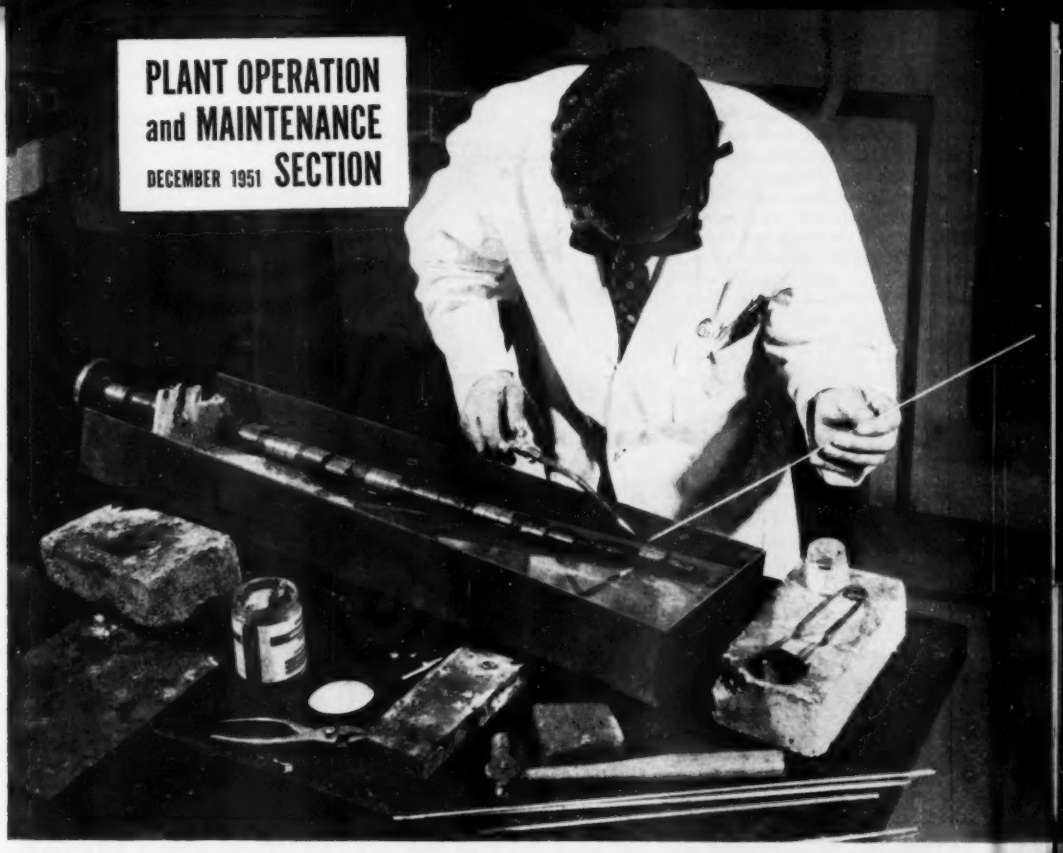
This valve has a throttling action to provide a continuous flow, but shuts off tightly against steam.

Steam jacketed asphalt lines and a jacketed pump at Globe Roofing Products Co., Whiting, Indiana, are drained by Sarco No. 871 steam traps.

Condensate is discharged to the sewer without excessive heat loss.

Note Sarco Strainers protecting the trap valves against dirt and scale.





WORN CAM is built up by welding while shaft is submerged in water almost up to flame. Water carries heat away from cam before it warps shaft. This is one build-up job where the slightest warp would ruin shaft. Then grind cam to shape

1 CAN'T GET NEW PARTS? Easy to build up the old; speed repair, save $

Four Life-Saving Tips for Plant Maintenance

► HAVING TROUBLE getting replacement parts for internal-combustion engines because of metals allocation, etc? Welding often saves the day—returns equipment to the firing line same day, instead of keeping it out of commission many weeks.

I built up worn camshafts as in photo. Then, after grinding the cams to correct shape, camshaft was good as new. Wear-resistant properties of weld outlast a new shaft.

I used EutecRod 50H, a special flux-coated hard-overlaying-type alloy with Rockwell hardness up to C 61. I deposited two passes of alloy on each cam lobe; only the tip (small radius) portion of the cams needed to be built up as dwell and accelerating sections showed little wear.

Before welding, thoroughly clean cam tips to remove all traces of grease, oil, dirt, scale or oxides. (Wire-brush, sand-blast, or give a good scrubbing with carbon tetrachloride or other chemical solvent.) After precleaning, heat each cam to be welded until surface begins to "sweat." At the same time, rub end of flux-coated rod on surface so some of this flux adheres to weld area.

Use a strongly-excess acetylene flame. When flux transferred to weld area begins to liquefy, indicating proper bonding temperature in base metal, deposit EutecRod 50H (FC).

This rod is a bead-forming alloy. It's deposited on work drop by drop.

For more Life-Saving Tips, turn page

FOUR LIFE-SAVING TIPS *continued*

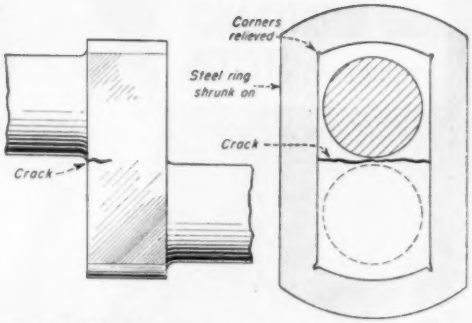
As each drop is melted onto the work, heat across work with torch until bead flows out and bonds to base metal. Then add another drop of alloy.

I welded these cams with camshaft almost completely submerged in water, photo. In fact, the trough and camshaft were so arranged that water came to within ⅛ in. of weld area. Water dissipates heat from shaft, thus eliminates risk of warping shaft. The slightest warpage makes the work useless.

Compound visible at far end of camshaft, holding it in place and keeping water in trough is Form-A-Jig. That's a plastic cement compound that doesn't swell, move or deform during welding operation. It often saves having to make up expensive jigs or fixtures for a single welding task.

While in this instance I made the repair with an oxyacetylene torch, the same job can be done with arc-welding.

FRANK ROMANO *Flushing, N. Y.*



MACHINED RING was shaped to fit over cracked web, shrunk around it tight; held web together until new shaft arrived

3 CRANK REPAIR

The cracked crankshaft can be used in a pinch if web is as shown here

ONCE A YEAR our maintenance staff opened both cylinders and valve chests, changed piston rings when necessary, and made adjustments and replacements.

The engine, a vertical noncondensing compound, with cylinders 13 in. and 24 in. by 12-in. stroke, is "oldtimer," with 32 years of hard work. Now because of new-fangled ideas of deflection testing the crankshaft (Operators' Notebook 45, p 110-111, Sept POWER) we were in trouble.

A dial indicator in the high-pressure crank gap, showed a maximum deflection of 0.004 in., when jacked around in four positions. That wasn't so bad, but the low-pressure end readings varied from 0.006 to 0.020 in. over the four positions.

After rechecking and trying to make the dial read a little more in one position and a little less in another, we had to admit something was badly out of line. We cleaned the shaft and chalked suspected parts. Then a fine fracture showed up, extending right across a low-pressure crank web, as in sketch.

We had to keep things going until we could get a new crankshaft, or better still, a new engine. A forged steel ring, 2 in. thick and 3½ in. wide, shaped to fit the web, solved our problem.

Ring was machined out on inside, about 1/64 in. less than web. Then we expanded it by heating to a bright red, and shrunk it on.

With the main bearings all realigned, the repaired shaft is giving good service.

The fracture must have taken some time to develop, but our deflection test caught it in time to prevent a serious breakdown and loss of production.

W A HERRON *Montreal, Can.*

2 BRAZING BREAK

18-in. cast-iron steam fitting repaired like new

WE DID an emergency job on an 18-in. cast-iron flanged fitting. It was part of a steam line, laid in trench about 8 ft below ground level. It carried 50-psi steam. The fitting cracked when flooded from a nearby river.

We built an oven of firebrick to preheat the fitting before welding. Bronze welding rod was used. Homemade clamps held the broken pieces in place, until they could be removed.

At time of break, we could get no promised delivery time on a new fitting. This job held well. It was a long time before it was replaced. When changed, the old fitting still looked good. I hope this helps some other POWER readers.

E E SMITH *Scranton, Pa.*

4 VALVE DECK CRACKED?

Here's one way to keep pump running until a new deck can be installed

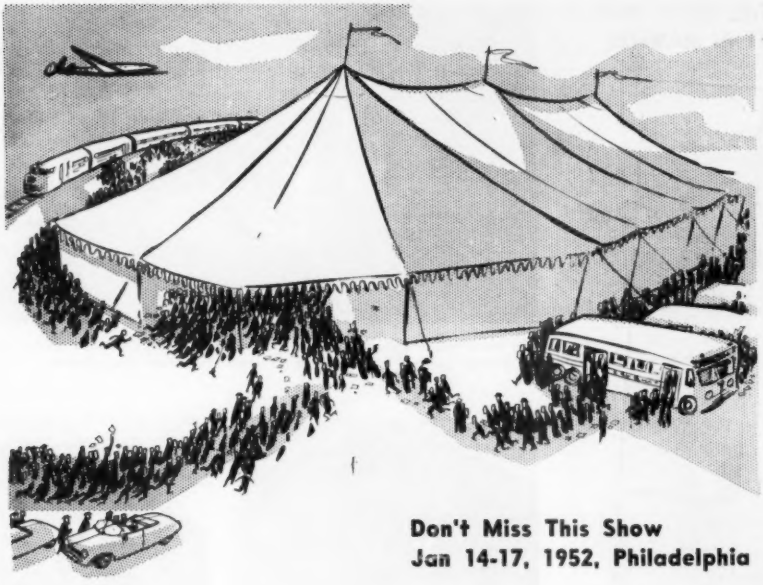
THE CAP over the discharge-valve deck cracked on one of our direct-acting boiler-feed pumps. The crack was in the center of the cap and ran to within 3 in. of its edge. Welding equipment was not at hand and our reserve pump was too small to take the load, so we had to make a hurried repair.

We drilled and tapped holes for pipe plugs at each end of the crack to stop it going farther. Then we drilled and tapped four holes on each side of the crack for ½-in. capscrews. Steel strips 1½ in. wide by 4 in. long were cut to go across the crack. Before laying out the holes in them we heated the strips.

The holes were then drilled on the same center distance as those in the valve-deck cap. While being drilled the strips cooled and had to be reheated before the hole came in line for the capscrews.

A thin red-lead mixture was poured onto the crack and the strips bolted on while they were hot. When they cooled they shrunk enough to close crack tight.

C A ARMSTRONG *Chicago, Ill.*



Don't Miss This Show
Jan 14-17, 1952, Philadelphia

Don't miss...

Your Biggest MAINTENANCE SHOW

► FIVE TIMES BIGGER than the first show held two years ago in Cleveland, 56 speakers and 225 manufacturers will *tell* you and *show* you how to do Preventive Maintenance for War Production. The place: Convention Hall, Philadelphia. Jan 14-17, 1952.

For advance registration cards, write to Clapp & Poliak, Inc. 341 Madison Ave, New York 17, N. Y.

Defense Production Administrator Manly Fleischmann will head group of 56 speakers. Highlight of the conference, held in conjunction with show, will be more than 30 sessions for special talks on individual industry needs. This will also permit discussion of problems in plants of various sizes. More than 14,000 are expected to attend. Besides, displays of latest maintenance equipment will be of record proportions.

Conference is sponsored by the American Society of Mechanical Engineers and the Society for the Advancement of Management. The American Society of Lubrication Engineers will conduct the panel on lubrication.

Here are industries to be covered: chemical plants, and metal-producing, metal-working, aircraft, food, glass, oil, printing, pulp-and-paper, textile and woodworking plants.

Particular problems to be discussed include maintenance of plant buildings, electrical equipment, mechanical equipment, power-plant and service equipment, and materials-handling equipment.

General sessions will be on maintenance costs, project preparations, inspection methods, scheduling of maintenance work, training workers and supervisors, personnel, operating policies, safety and plant protection, housekeeping and welding for maintenance efficiency.

Program. Topics of interest to POWER readers will be covered in morning, afternoon and evening sessions:

Monday, Jan 14: Maintenance Costs—five speakers; How to Maintain Plant Buildings—two speakers; Maintaining Electrical Equipment—two speakers.

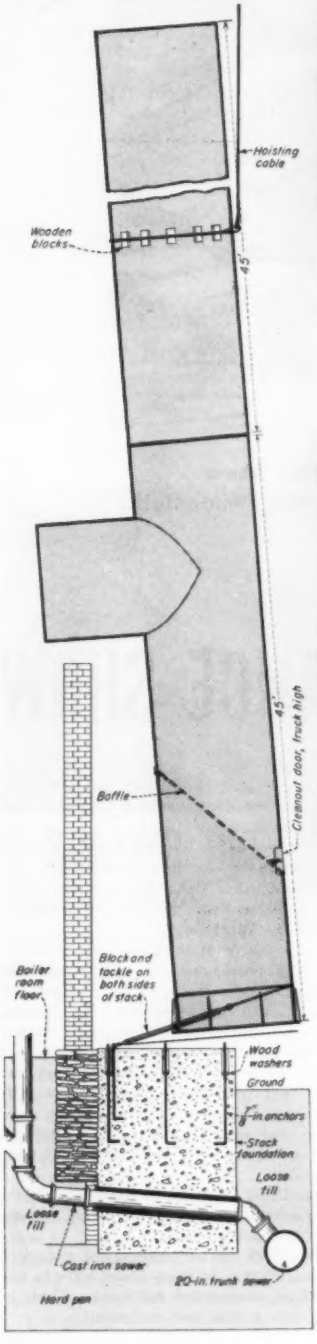
Tuesday, Jan 15: Preventive Maintenance—one speaker; Inspection Methods and Records—one speaker; Planning and Scheduling Maintenance Work—one speaker; Maintenance Problems in Small Plants—four speakers; Maintenance Problems in Medium-Size Plants—four speakers; Maintenance Problems in Big Plants—two speakers.

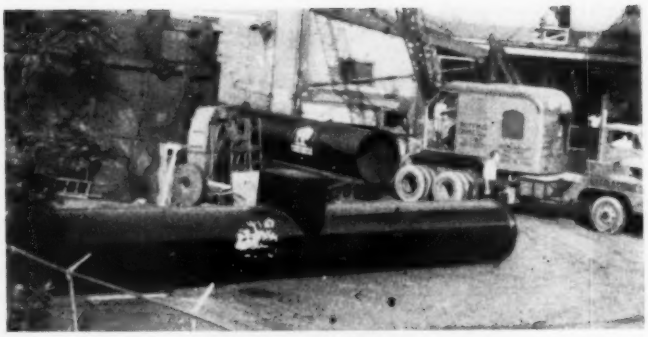
Wednesday, Jan 16: Training Maintenance Workers and Supervisors—one speaker; Lubrication—five speakers; Organizing the Maintenance Personnel—one speaker; Safety and Plant Protection—one speaker; Plant Housekeeping—two speakers; Maintenance of Power-Plant and Service Equipment—two speakers.

Wednesday evening: Plant maintenance banquet at Hotel Warwick. Manly Fleischmann will speak on the subject, Plant Maintenance in National Defense.

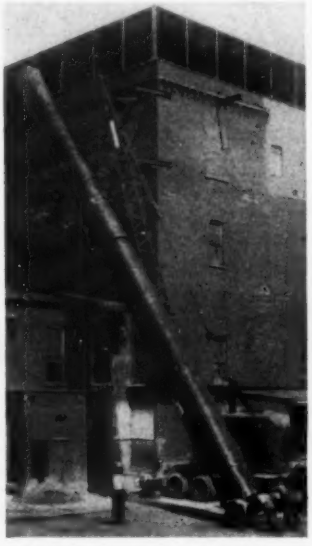
Don't miss this show. With industry calling for more and more power, here's your chance to learn about ways to get most out of your already overworked machinery. Cash in on latest maintenance-saving ideas and equipment.

UP GOES THIS HEAVY 90-FT STACK, 6 FT IN DIAMETER

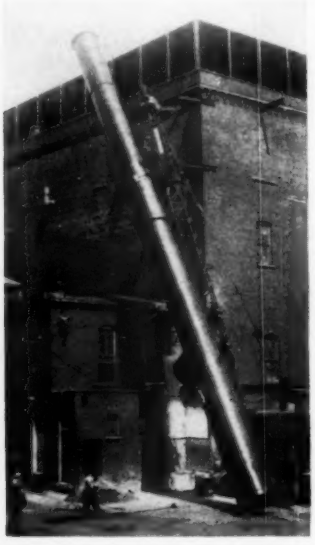




1 Truck delivers stack in two 45-ft sections. Then crane unloads each section and swings second half so that it is in line with first half for bolting together



4 Crane hoists slowly as ground crew keep moving skids under stack's end



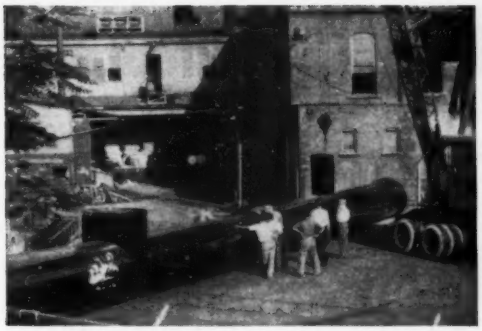
5 Men get ready to rig the hold-back blocks to prevent the stack swinging

Raising a Steel

► AN EXPANSION PROGRAM to increase a plant's brewing capacity about 50% called for a new stack.

The square brick chimney, 39½x 38½ in. at the top, and 85 ft high, was old and unsound. At the base, bricks had disintegrated, extending up about 10 ft on two sides. Chimney's outlet was reduced to about 6 sq ft by a hard layer of soot and ash 9½ in. thick. That layer extended down the flue, starting 5 ft from the top. Trouble was proposed repairs were not practical because they would take longer than the time plant could be shut down.

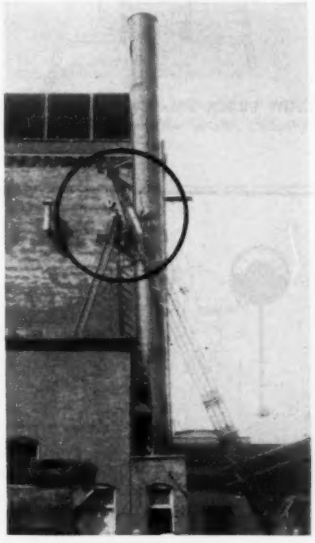
This plant had two 78x18ft. 40-yr-old hrt boilers, low set and hand fired. An extra gas pass, also hand fired, extended over boilers' tops to the back end of the setting, connected direct to the chimney base through separate openings. Two more hrt's. 72x18 ft. were underfeed, stoker-fired. These boilers were connected to the chimney



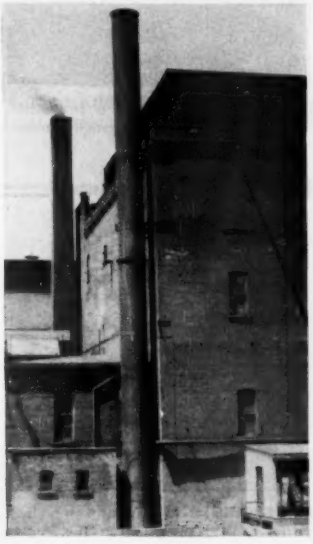
2 With halves bolted together, steel cable is fastened around the stack. Wooden boards under cable protect the stack

3 Rigger on boilerhouse roof helps stabilize stack. Crew on ground move skids along ground under the stack's base

6 Blocks now set so the stack can be pulled into place easily on its base



7 Stack is placed over anchor bolts as men place straps onto the brackets



8 Completed job, with breeching hole bricked up and stack ready for use

Stack?

Here's a step-by-step account of how S C Page, consulting engineer of Rochester, N. Y., raised a steel stack for an old brewery

with 50 ft of 54-in. square breeching.

Boilerhouse is 84x23 ft. Inside is a lean-to on the adjacent refrigerated beer-storage building. Any temperature reduction made in the boiler room would reduce refrigeration load in adjacent building.

The 78x18 ft boilers were being replaced with a modern package-type watertube boiler with spreader stoker. This boiler had both forced and induced draft, to top about 15,000 lb of steam per hr. Package unit would use the old brick stack.

Repairs as Revised. The new stack installed is 6x90 ft and handles the two stoker-fired boilers for the present. Later it will service a larger unit also.

The most logical location is shown in photos, even though the toilet room had to be cut off 7 ft and sewer lines rearranged to accommodate foundation.

The foundation is shown in sketch, also pull-in blocks used. Blocks were planned to land the base of stack on foundation when stack was hoisted to clear anchor belts. With two sets of blocks, the stack was rotated slightly to align holes perfectly with bolts.

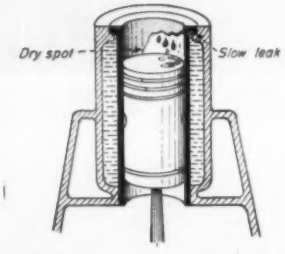
We anchored the stack to the building with two bands and brackets, secured to the steel structure inside the brick wall with through-bolts. Then bolts were grouted in the wall to keep out water and make a neat job. Planning made this job go up very smoothly.

OPERATORS' NOTEBOOK 48

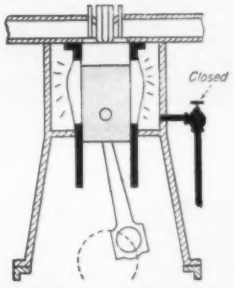
Your Liners Can Crack

SLOW CRACKS

LINERS USUALLY CRACK a few inches from top—run circumferentially around

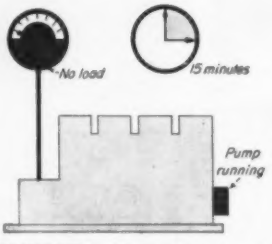


SLOW CRACK allows water to leak into cylinder. Water washes off cylinder oil

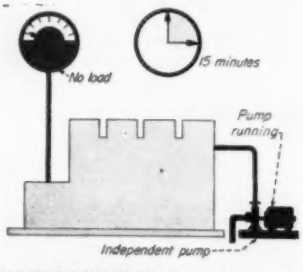


DRY SPOTS rust when engines shut down. Then liner heats fast, seizing the piston

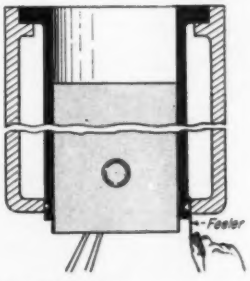
HOW TO PREVENT Continued



RUN ENGINE for 15 minutes with no load if the cooling pump is on the engine

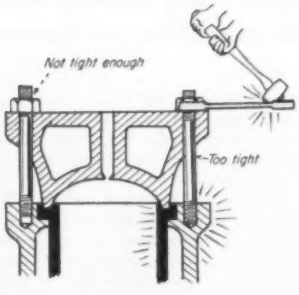


ALWAYS COOL SLOWLY by unloading for 15 min; then run pump another 15 min

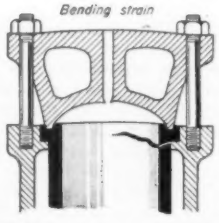


BUILD UP METAL with welding torch if no metal-to-metal contact at the bottom

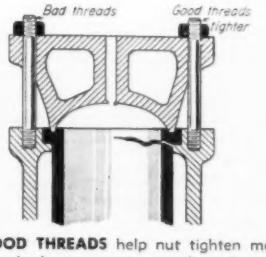
CAUSES



UNEVEN TIGHTENING or too much tightening of cylinder head bolts is bad



TOO TIGHT bolts cause bending strain on cylinder head—transmitted to liner

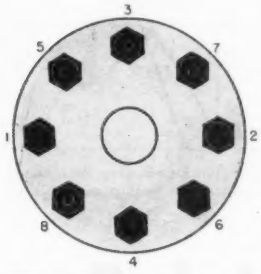


GOOD THREADS help nut tighten more than bad ones—torque wrench reads same

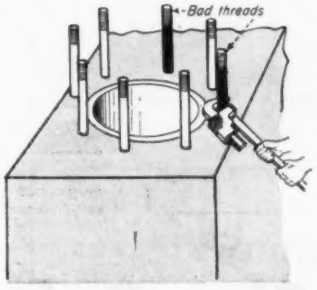
Unless You Stop Them

By **STEVE ELONKA**, *Associate Editor*

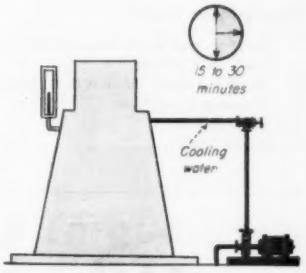
HOW TO PREVENT



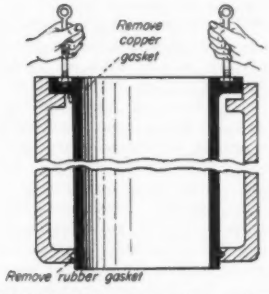
TIGHTEN NUTS in sequence shown. Take up slack on all, then drive them tight



REMOVE BOLTS and nuts with damaged or worn threads and replace with new

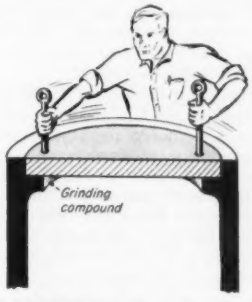


RUN COOLING WATER 15 to 30 minutes after shutting down to cool the engine

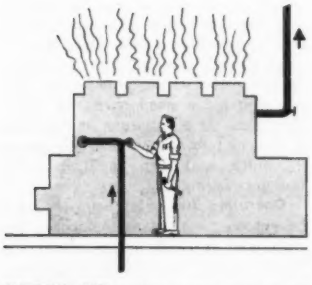


PRUSSIAN BLUE under collar, and turn the liner slightly to mark the high spots

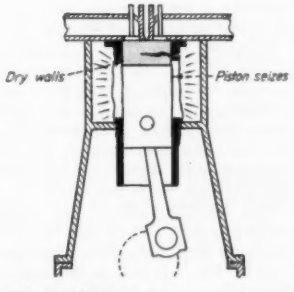
SCRAPE HIGH SPOTS shown by prussian blue until the bearing surfaces are level



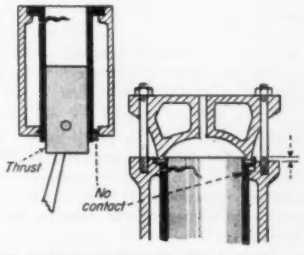
GRIND BEARING smooth with cast-iron plate. Use new copper and rubber gasket



CUTTING OFF cooling water soon as the engines shut down overheats the liners



PISTON RESTS in same spot each shut-down with water off, overheats the liner



NO CONTACT between liner and block at the top or bottom from warped casting

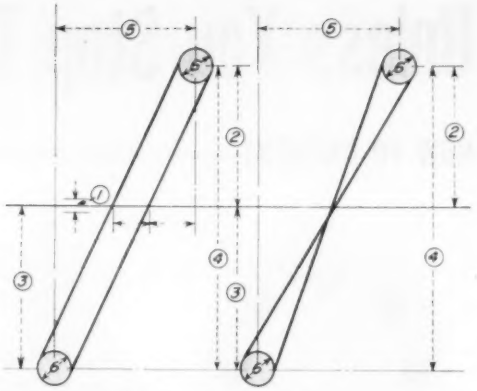
DATA SHEET: HOLE-LOCATION INDICATOR

Information required for use:

1 Thickness of floor
2 Distance from center of loom pulley to floor
3 Distance, ceiling to center line of shaft
4 Vertical distance, loom shaft to line shaft
5 Horizontal distance, loom shaft to line shaft
6 Diameters of line-shaft and loom pulleys

Weave-room number:

Location: area bounded by post numbers
Loom make and size
Number of looms: (Straight belt) (Crossed belt)
Dimension of belt holes
Width of belt
Angle of belt



1 Mimeographed form calls for step-by-step measurements of belt-driven machines placed on floor above drive shaft

What Size Belt Hole?

► SUPPOSE YOU HAD to relocate several hundred belt-driven machines all of the same general type, but the belt drives were almost anything, flat belt, V-belt, what have you? One thing sure, it's enough to swamp anyone.

That's just the kind of job that was dumped in my lap. We were pushing through a heavy plant-modernization program with one big objective in mind. That was to smooth out flow of material. Those several hundred belt-driven machines had to fall in line. What's more, we felt the plant appearance would be improved if we put the drive for these machines on the floor below. Then the belt runs could be shortened and a lot of the overhead confusion removed.

Spotting Holes. One of the biggest problems to crop up was the one of size of belt hole and where it ought to go. We played around with several ideas on spotting pulleys, like, for instance, measuring the horizontal distances from a certain wall to machine pulleys and lineshaft. Then we thought we would work up a master-plan chart. With a floor between lineshaft and machines, however, there was too much chance of a slip on somebody's part.

Here's how we tackled the job. We began by drilling a small hole up through the floor at each end of the lineshaft. Then we drew a chalk line between them so center of lineshaft was positively located on the working floor level above.

Shortcut Indicated. Next we gave the millwrights a mimeographed form with step-by-step measurements and typical belting arrangements, Fig. 1. On these forms, properly filled out, we added the exact dimensions of the belt holes from a specially designed belt-hole indicator, Fig. 2.

This indicator is an 8x8-ft masonite panel painted white. A horizontal line across the panel represents the floor line. Panel is mounted on a $1\frac{1}{4}$-in. pipe frame with two cross members, also of $1\frac{1}{4}$-in. pipe. All fittings except those used as the floor supports are sliding tees.

When the millwright's mimeographed form, Fig. 1, comes in, one man picks out masonite disks of the same diameter as the reported pulleys. These he puts on the indicator with the proper vertical and horizontal spacings as recorded on this form, as well as the vertical distances with respect to the floor level. Strings are then run over the disks in the same way as the belt drive, that is, crossed or straight.

The finished setup, Fig. 2, allows you to pick off the belt-hole size directly from the indicator. What's more, spot it exactly with relation to the center of the driving shaft and the center of the driven-machine pulley. This information goes in the mimeographed form and back to the millwright.

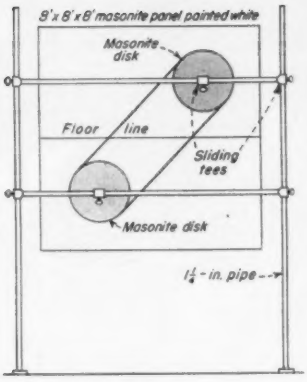
With the line shaft located on the working floor by a chalk reference line, above, the belt holes went in without a hitch. The men took to the idea like ducks to water. In fact, results were excellent. At the same time we had a chance to review some of the basic installation and maintenance do's and don'ts for all kinds of belts.

Belt Maintenance. For flat belts these are typical, sound installation pointers: Don't try to run belts on flat-faced pulleys except on idlers and shifter drives. Where you use idlers, check idler-pulley arrangement. Don't let belts run against stationary objects like the sides of belt holes in the floor. All it does is break edges of belt, and soon the ply separates. Don't use crowned idler pulleys. They put a reverse bend across the belt's width that can lead to ply separation, blistering or fastener failure. For that matter, too high a crown on a pulley puts so heavy a strain on the center of the belt that the ply pulls apart and the fasteners fail 'way before their time.

When it comes to putting a flat belt over a pulley, everyone knows you should never force or pry the belt on. Nor, for that matter, should you use a rope in installing a belt. Once the belt is on, though, make sure its center runs on the center of the pulley-face. This way you get a good check on pulley alignment. If a belt runs on one side, it is bound to stretch unevenly across its width, and then you'll have the fasteners failing.

Operating Tips. Flat belts shouldn't be put on too tight or too loose. Too tight, and the belt cracks, then fails. What's more, the shaft bearings overheat from too tight a belt.

Yet if the belt runs too loose, it slips



2 Once data are in, *left*, they're put on the indicator, *above*, to get hole size

By **N FORMBY**, *Montreal, Quebec*

all over the place. The frictional heat it kicks up burns and cracks the belt surface so much that its life is cut short.

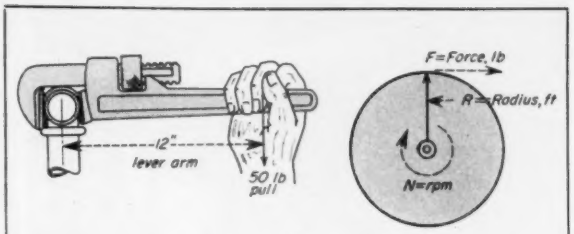
What you should do is work with a speed counter and the pulley ratios to check slip and creep. For a good flat-belt installation, creep and slippage should never be more than 2%.

V-belts can also profit from some straightforward do's and don'ts. For instance, it's good practice to apply a little higher tension than normal with a new set of belts to allow for initial stretch and groove seating. Then check for stretch and sag during the breaking-in. It's also smart to put in well-ventilated guards so heat build-up stays within bounds. V-belts operating above 140 F, as an example, will overcure any rubber in their makeup. That will shorten belt life.

Never force or pry a V-belt. Instead release the take-up. Never mix new belts with old on the same drive. Manufacturers suggest you install matched sets.

How about operation? Well, some quick tips on operation include never using a belt dressing on V-belts, nor idlers to put tension on them. Then, of course, be sure sheaves and shafting are in perfect alignment. If any burns or sharp groove corners develop on the sheaves, replace them; otherwise, the belt will fail sooner or later.

Summary. All in all what started out to be a complicated, highly detailed pully-replacement-job broke down under planning into an orderly house cleaning that has paid off.



TORQUE, or twisting effect, is force times lever arm over which it acts. When you convert to horsepower you have to know how far you moved a shaft, and also just how long it took. Then apply the formula below

Figuring Torque

► BIGGEST PROBLEM you'll face in figuring out mechanical power-transmission loading is to get your ideas straight. And all the confusion comes from not fully knowing the difference between torque and horsepower.

Torque is simply the force that spins or tends to spin a piece of equipment, say a shaft or wheel. Fig. 1 shows how torque is applied. Or if you want another example, suppose you hang a weight from a hoist drum. That weight will put a twisting moment in the drum shaft. You can measure that moment by multiplying weight in pounds by radius of drum in inches. Answer will be torque in lb.-in. ($t = W \times R$)

Horsepower is a lot different. It's the rate of working. And you need to know how much weight was moved, how far, and how long it took. For example, one horsepower is equivalent to raising 33,000 lb one foot in one minute:

$$Hp = \frac{\text{ft} \times \text{lb}}{\text{minutes} \times 33{,}000}$$

If you know the torque set up on the hoist drum used for an example above and how fast it spins the drum in rpm, you can figure the work it does in horsepower. Here's how to do it. You get the answer from torque in lb-in., multiplied by shaft turns in revolutions per minute and then divided by 63,000. Horsepower then equals torque × rpm divided by 63,000. Or torque equals horsepower multiplied by 63,000 and divided by rpm.

Let's try a problem: Torque of a 1-hp motor at 1750 rpm is:

$$t = \frac{1 \times 63{,}000}{1750} \text{ or } 36 \text{ lb-in.}$$

Or from the opposite approach, what's the horsepower equivalent of a 1500 lb-in. torque at 10 rpm?

$$Hp = \frac{1500 \times 10}{63{,}000} \text{ or } 0.24 \text{ hp}$$

Suppose you connect this 1-hp motor by pulleys, belts, gears, chains, sprockets, or what have you, to get a speed-reduction ratio of 100:1. Then output torque is 100 × 36 lb-in., or 3600 lb-in.

Whenever you're working on slow-speed jobs—conveyors, hoists, agitators—start with the load and figure back to find what input torque you need. It will save using too heavy motors or speed-reducing transmission equipment.

Here's an example or two: An elevator or hoist has a 2000-lb load. Hoist-drum dia. is 12 in; speed 50 fpm. What hp motor at 1750 rpm do you need?

$$\text{Rpm} = 50 \text{ fpm divided by } \pi \times d = \frac{50}{1\text{-ft dia} \times \pi} = 15.8 \text{ rpm}$$

$$\text{Ratio of reduction needed is } \frac{1750 \text{ (motor rpm)}}{15.8 \text{ (drum rpm)}} = 110{:}1 \text{ (about)}$$

$$\text{So torque at 1750 rpm then equals } \frac{12{,}000 \text{ lb-in.}}{110 \text{ ratio}} = 109 \text{ lb-in.}$$

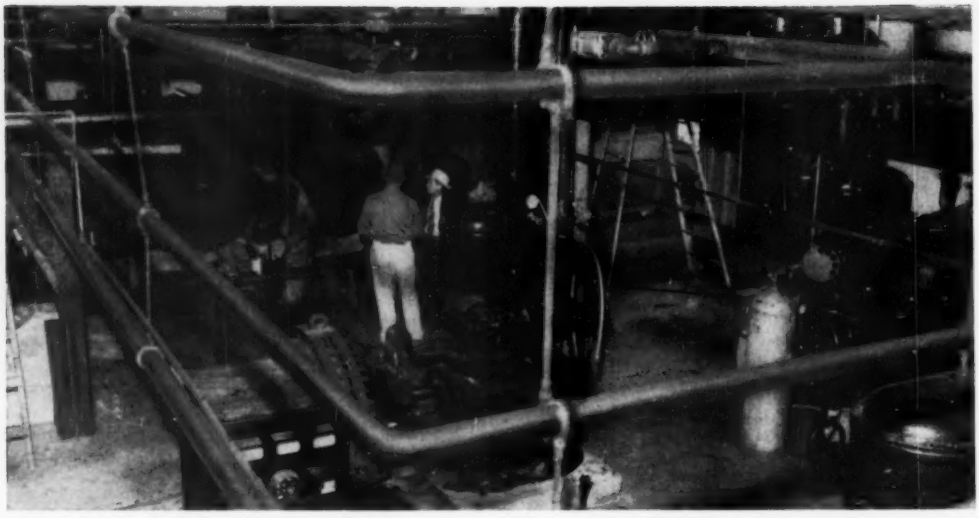
$$\text{Hp becomes } \frac{109 \text{ lb-in.} \times 1750 \text{ rpm}}{63{,}000}$$

or 3-hp input (motor size)

How about efficiencies? We haven't said anything about them, but they must be figured in. All power-transmission equipment dissipates into heat some of the energy put into it. This heat is lost power.

Manufacturers' catalogs and handbooks give data that take into account equipment efficiency. With this data the proper motor size can be picked to give you full power.

JOHN DENHOLM, *member Power Transmission Council*



STICK CLOSE to mechanics installing equipment during this period. Regardless of how well the job is done, your plant will have bugs to iron out after you start it up, especially if it's a big installation. Check equipment with blueprints

Install Cold System Right

By **TERRY MITCHELL**, *Frick Company*

EDITOR'S NOTE: *Here's the second article on installing refrigeration systems. Terry Mitchell's first article, "Make Your Cold System Shipshape," appeared in October* POWER, *pp 116-117.*

► HOW WELL your new refrigeration plant works depends a lot on how well you plan and supervise the actual installation.

Outboard Bearing. Here's how to align a separate outboard bearing, assuming that the compressor has been placed in proper position but not grouted fast. Raise the shaft a few thousandths with blocking, to keep it from sagging under its own weight. Amount shaft must be lifted depends on its size and unsupported length: The whole idea is to keep it straight. Then place outboard bearing on shaft and wedge-up on bearing until bottom of babbitt is in firm contact with shaft metal. If bearing is split type, remove shims and clamp to shaft. Make sure base is level.

A safer way is to check the straightness of the shaft with a "strain gage" (Operators' Notebook 45, Sept 1951 POWER) before castings are grouted.

Compressor. If possible, don't open compressor crankcase. The machine has been cleaned and adjusted at factory. Too often lint, dust and moisture get into it while open. Also, waste, scrapers, and other tools are left inside.

Machines. Remove cylinder heads of horizontal-type machines. Place pieces of lead where pistons flatten them when heads are replaced. Measure leads for thickness and keep as a record. Piston clearance at crosshead end is made less, because piston rod heats in operation and expands.

Piping. Specify extra-heavy pipe for the high-pressure side of system. Use extra-heavy nipples throughout. Weld nipples to coils' ends that are submerged in brine of ice-making tanks. That reinforces threads.

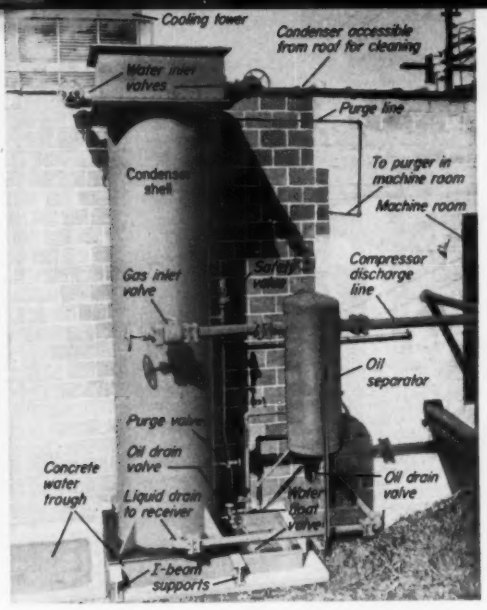
Water pipes connecting condenser, machine jackets, pumps and other parts of plant should be galvanized. Install as indicated on drawing. Don't forget to provide for draining water in freezing temperatures. This is very important at compressor's water jackets. There piping must be installed so jacket's upper parts do not become airbound. Air in jackets cause overheating.

When installing Freon equipment, take every precaution against moisture and dirt entering. Avoid using pipe with a mill-oil coating inside. Clean pipe walls to bare metal. Freon-12 is heavy, operates at low pressure. Several times as much Freon-12 has to be circulated to give same effect as ammonia. That's why pipe sizes should be amply large. If liquid line from receiver rises 50 ft or more, vertical head decreases pressure at the top. Then gas forms, and you will need an expansion valve with a large port.

It's best to weld steel pipe used with Freon. Make final weld near a flanged joint, so line can be cleaned. Keep weld a foot or more from flange, or heat may injure threaded joint. Peen all threaded connections of pipe ends, over two inches in size, with a hammer. Peen inside the flange. Extra-heavy pipe doesn't loosen easily from vibration.

Litharge and glycerin are OK for making up threaded joints in Freon piping. Special gaskets and valve-stem packing are used for this refrigerant. When ordering valves and fittings, state "for use with Freon-12."

Copper and brass pipes are easy to handle in smaller sizes. They are connected with flared or soldered joints. Grease, moisture, dirt or oxidation is picked up and carried to machine by Freon, so be sure pipe is clean and dry. Clean pipe and fittings with steel wool.



RIGHT HOOKUP of vertical shell-and-tube condenser for a small plant. Always place condenser on building's shady side

Check These Points

1 Outboard bearings lined up?
2 Piston clearance right?
3 Do cooling jackets have drains?
4 Freon pipe scaled?
5 Right pipe sealing compounds?
6 Extra heavy pipe used?
7 Pipe hangers in right spots?
8 Vibration prevented?
9 V-belt pulleys lined up?
10 Machines turn right direction?

then make up joints promptly. Be sure tubing has square ends, is a close fit, and is not flattened.

Solder pastes like No-Korode and Streamline are good fluxes. Spread flux in a thin, even coat with a dry brush after warming pipe to about 80 F.

Don't use solder with an acid core, as flux inside is frequently corrosive. A "95-5" solder is acceptable in Code regulations of most cities.

Heat entire joint, both pipe and fitting evenly, and just enough to melt the solder before it's applied. Fill all cracks with the solder, but don't get it too hot.

Use soft copper tubing annealed at end if necessary for flared joints. Oil the flaring tool and avoid thinning metal. Use special nonfreezing or "vented" nuts on flare connection that will frost.

Make lines short as you can. Avoid diagonal pipes and fit with suitable strap iron hangers. On suction lines, allow space for insulation and a sheet-metal sleeve inside the hangar. Brace pipes carrying Freon with extra care, as this heavy gas tends to cause vibration. If brackets carry vibration to building, fasten piping to foundations or to machines, or to one another.

Vibration either telegraphs as noise, or appears as a rattle in a distant spot. Firmly set Freon condensers on concrete, to prevent tubes from shaking and becoming loose. If condenser is over 20 ft from compressor, install a surge drum in discharge line to eliminate vibration. Condensers placed above machines may vibrate.

Strainers. Install strainers just ahead of automatic expansion or solenoid valves. A "sump leg" will catch grit, if put where flow direction and speed change suddenly.

Driers. Use driers of activated alumina or silica gel in Freon systems. Arrange liquid line so drier can be removed after 12 hours' service. If left in line too long, an alumina drier gives off a white powder. Powder gathers in a puttylike mass at expansion valves, being too fine for strainer to catch. Water is worst enemy of a Freon system. Make every effort to get rid of it. But some freezing-up at regulating valves has lately been traced to waxes in unsuitable oils.

V-belts are favorite drives for small and medium-sized machines, and synchronous motors for large ones. When installing V-belts, move motor toward compressor so belts can be placed in grooves easily by hand. Forcing canvas-covered belts into grooves with screwdrivers, bars or wedges, or by turning the wheels, injures the fabric. See that sheave is in line with flywheel when belts are tightened. Caution: don't make V-belts too tight. Keep them free of water, oil, grease, which rot rubber.

Motor. Put shims furnished with a synchronous motor carefully between feet of stator and base plates. Removing a shim permits lowering stator to allow for bearing's wear. It's good practice to grout outboard bearing in position before bolting a split flywheel or rotor on compressor shaft. Don't run machine until you oil and pack shaft seal as instructed.

For safety, avoid using rickety ladders, chains with bolts where links are missing, and tools with burred edges. Remember, hot tar causes burns very difficult to heal. If you must make welds on existing pipelines or shell vessels, be sure pressure has been relieved. Also, that refrigerants, oil and other explosive mixtures are drained out and replaced with fresh air. Don't use compressed oxygen instead of compressed carbon dioxide in testing for leaks; oxygen may ignite any oil in system.

Screw valves onto threads with wrench on pipe end. Wrench on opposite end twists valve, causing it to leak. Keep electric motors, switches and wiring dry. Check turning direction of machine before running it, because oil pump may have to be adjusted to suit rotation. Remember that safety valve built into compressor manifold cannot be isolated by closing main stop and bypass valves. This relief valve always has the discharge pressure on one side and either suction or atmospheric pressure on the other. If the safety valve leaks and has to be opened, first relieve pressure on both sides by pumping down; also loosen a joint.

BOEING AIRCRAFT CO, Seattle, Wash, has building covering 41 acres. Today the plant has 54,724,062 cu ft of space, 30 miles of steam piping, heating systems including direct radiation using steam, forced air and even electric cables

Boeing Goes After Soaring Btu's...

Sets up special heat-chasing department

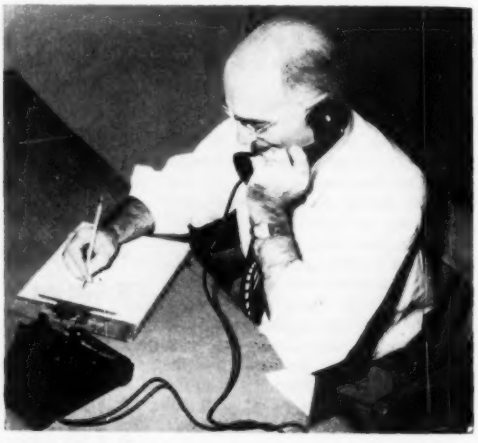
Makes more use of recirculated air

Keeps constant patrol of 30 mi of piping

Holds zone temperatures at design levels

Anticipates demand swings in heating

Reduces its total heating bill 25%



HANGAR HEATING is tough; drafts develop easily, require deflectors, or air-supply changes; often it's just carelessness

► YOU'D THINK anybody could sell management on a heating bill savings of $100,000 annually for a cash outlay that's a fraction of it. This proposition was worked up by the plant engineering department of Boeing Aircraft Co in Seattle, Wash. On the surface it sounds sure-fire, but any plant man will tell you it takes a deal of doing.

Basis of the whole plan is to cut down on unnecessary heat waste—a sizable and generally recognized weakness of almost every industrial plant. Boeing decided to tackle this problem soundly.

They have set up a maintenance heating dispatcher's office with a crew of four co-ordinators as they are called. These co-ordinators stand by to track down any and all complaints about building heating. Under a program of close control over waste heat you can expect a lot of complaints that are highly individual and purely personal.

Once a co-ordinator runs into one of these he turns the hot potato over to W B Pride, chief heating and ventilating engineer. The permitted temperature in office areas is 72 F and in the plant 65. Many a front-office secretary used to a hothouse environment of 78 or so has put in a complaint. Chief Pride has been able so far to win them over with (1) graphs showing temperatures at which working efficiency and health are highest. (2) Meters and recording instruments to prove to them their areas are maintained at these peak points.

Working with the co-ordinators are four "heat-run" men who are constantly

CHECKING UP on heat distribution and waste is the job of Watt Evans, heating dispatcher

COMPLAINTS about building heating come to dispatcher's office, are assigned to a heat co-ordinator. If they're minor he corrects them, but reports fully

RECIRCULATING AIR means money; an extra 1000 cfm saves $35 per 8-hour shift per year

BACKBONE of expected $100,000 yearly saving is close knowledge of plant layout, nature of heating system in each area, type of heating load foreseen

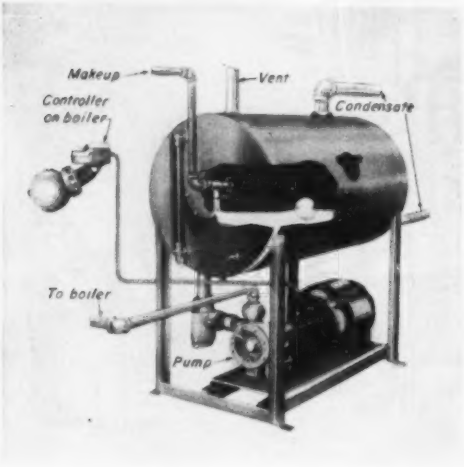
on the go throughout the plant—two on the first shift, one on each of the other two. They run checks on temperatures, change controls, open or close valves, start or stop fans—whatever is necessary. First-shift men repair thermostats while those on second and third shifts do some maintenance.

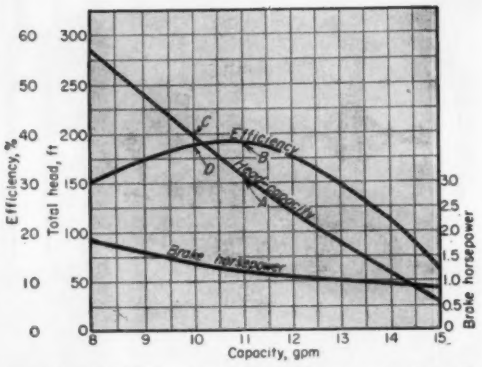
Boeing started its campaign in March 1950, mostly because more savings can be realized from March to October than for any other period. That's the time when people throw open windows if it gets too hot. Net saving from March through September, 35% of the heating season, was $46,551, a 23.85% improvement over 1949 for the same period.

When a heat-run man sees a window open he shuts off the heat, reasoning that it is no longer needed. He is constantly reminded by the heating engineering office that each extra degree of heat above 70 F boosts the heating bill 3 to 7%, depending on outside temperature. When outside temperature reaches 65 F, comfort heating mains are shut off.

Automatic regulation prevails in the larger working areas served by forced-air heating as compared to the manual controls—the smaller areas just described. Exhaust systems remove about 1,000,000 cfm of air, and only 15% of it is recirculated. Each 1000 cfm of recirculated air represents a $35 saving per 8-hr shift per year.

While the program seems straightforward enough and its aim understandable, it takes a lot of follow-up and close supervision to make it work.





1 **TURBINE-PUMP** head increases rapidly as capacity falls off. This characteristic has many advantages in certain systems

2 **PACKAGED** boiler-feed set includes turbine pump, condensate-return tank and makeup valve in one compact assembly

Turbine Pump in Demand

Of simple design with good characteristics, turbine pump finds wide use in small-capacity units with heads to 600 ft. Here's how to use it in boiler feeding, heating, refrigeration, air conditioning and many other important power and industrial jobs

► A REGENERATIVE TURBINE PUMP is a centrifugal type, designed to develop several times the pressure of a centrifugal that has equal impeller diameter and runs at the same speed. The pump has an impeller with vanes cut in both sides of rim, Fig. 3. The vanes run in an annular channel, Fig. 3, in the casing. Because of its many desirable features this pump is widely used.

Pump Sizes. Units are built in a range of sizes, nearly all of which have vertically split cases, Fig. 4 and 5. The pumps are coupled to the driving motor or close-coupled to flanged motors. They are built with pipe connections to 3 in., total heads to 600 ft, in a single stage at 150 gpm.

As a rule, viscosity of liquid pumped shouldn't exceed 500 ssu. The pumps have close-running clearances; don't use them to handle liquid containing abrasives or other solids.

Boiler-Feed Service. One important application is to feed boilers with up to 5000 sq ft heating surface at pressures of 60 to 250 psi. Here the pump doesn't run continuously, but is started and stopped by a water-level controller in the boiler, Fig. 2.

The pump's suction connects to a receiver of ample size. Makeup to receiver is regulated by a float or a valve controlled by a float switch mounted on receiver.

Select pump for a given boiler rating and pressure. It is usually selected from a cold-water performance curve for a capacity of 2.5 to 3 times rated evaporation of the boiler. Pump then runs less than 50% of the time boiler operates at 100% rating.

Select receiver tanks so upper half takes care of peak condensate returns. When returns don't meet boiler needs, makeup valve opens to hold water level at about the halfway mark.

As a rule, about 1 gal or more of tank capacity is provided for each 10 sq ft of boiler water-heating surface. If condensate returns are unusually large at times, they can be stored in a surge tank.

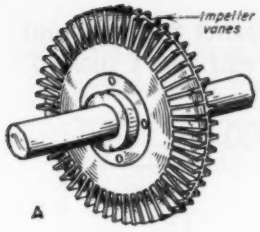
Boiler-feed unit includes a pump, tank, makeup valve and connecting piping combined in one package, Fig. 2. The assemblies are known as boiler-feed units or boiler-feed pump sets. They are used in dairies, laundries, dry-cleaning plants, and in food plants with a process-steam load.

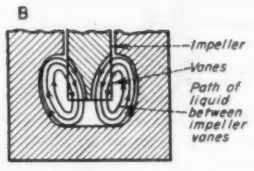
Because the pumps can develop high heads in small capacities and at comparatively good efficiency they are well suited to boiler-feed service. Since head-capacity curve is steep, normal changes in boiler pressure have little effect on discharge rate.

Rising Head Curve. In Fig. 1, a 3500-rpm pump has a rating of 11 gpm at 155-ft head, point *A*, and 38% efficiency, point *B*. Pump also delivers 10 gpm at 200-ft head, point *C*, and at about the same efficiency, point *D*. At 8 gpm, head increases to 275 ft, at about 30% efficiency. So if the pressure goes above normal it has little effect on rate at which water is fed to boiler.

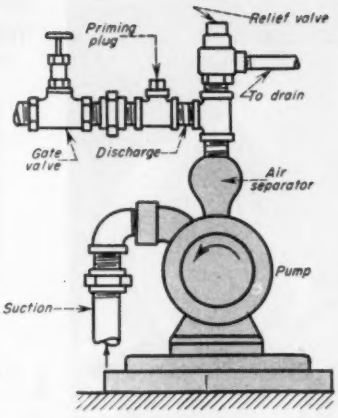
For 1750-rpm pumps, head-capacity curves don't rise as fast on decreased flow as for 3500-rpm units, but discharge pressure can become dangerously high at shutoff. Where there's danger of pump discharge being closed or throttled, use a relief valve as in Fig. 4.

Hot Water. Turbine pumps handle hot water without vapor binding. Standard boiler-feed units can generally be used for water temperatures to 200 F. Between 200 and 210 F legs are extra long, to raise condensate tank and in-

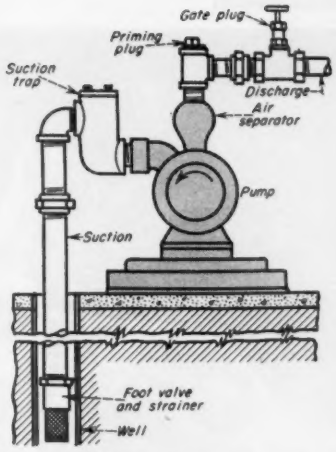




3 **IMPELLER,** *A,* has radial vanes each side of rim; *B,* liquid path in pump



4 **RELIEF VALVE** in discharge protects piping system against high pressure



5 **SUCTION TRAP** and air separating chamber make well pump self-priming

For Its Unique Features

By P M ROTH,
Application Engineer
Roy E Roth Company

sure enough suction head on pump. For temperatures above 210 F, the receiver tank is closed, operates under heating-steam pressure, and is not vented.

Condensate Returns. Turbine pumps are also used in condensate-return units where steam-heating boilers operate at 15 to 150 psi. On these jobs makeup water can be put directly into the boiler or into the receiver. Since receiver tank handles only condensate, tank need be only about half the size used for comparable boiler service. When returns accumulate in receiver a float switch starts pump to empty tank until stopped by low water level.

Two advantages of turbine pumps on heating-system condensate-return units are the small size and lower power use. A unit for 4000 sq ft equivalent direct radiation (EDR) uses a 6-gpm turbine pump driven by a ¼-hp motor. For 6000-sq-ft EDR, a 9-gpm turbine pump driven by a 1/3-hp motor is needed. Motors for these conditions are smaller than commonly selected for other pump types.

On condensate-return service where condensate must be handled at 190 to 200 F, a turbine pump does the job without vapor binding. Also, where only 25-cycle power is available pump speed is limited to 1440-rpm direct drive. At this speed turbine pumps handle condensate returns at discharge pressures two or three times that possible with common types of centrifugal pumps.

Air Conditioning. In refrigeration and air-conditioning systems, turbine pumps supply water to small cooling towers, for brine-circulation, recovery and transfer of liquid refrigerants.

When used on cooling towers the pump is connected to the intake side of the condenser. When connected this way, if condenser coils tend to clog, increased friction doesn't reduce flow much. This is because pump head rises rapidly as flow falls off, Fig. 1.

Pump Noise. In air-conditioning systems take care to dampen pump's noise. Turbine pumps usually have a low whine when operated against pressures above normal. So install these units where their noise won't be annoying. Connect to the piping system with hose sections to prevent noise traveling through the piping.

Since turbine pumps have almost constant discharge despite a certain amount of pipe corrosion they are used for handling brine. When they recover or transfer refrigerants, equip them with mechanical seals to stop refrigerant loss from stuffing box.

Shallow Wells. Fig. 5 shows a shallow-well pump installation. It is made self-priming by a trap and strainer in the suction line at the pump and an air-separating chamber in the discharge. Foot valve and strainer on suction-line intake improve operation.

In shallow wells, turbine pumps deliver nearly rated capacity on suction lifts to 22 ft. At 28-ft suction lift, capacity drops about 50%. Don't use these pumps for higher lifts. All-bronze units are generally used in brackish-water areas. This construction prevents excessive wear of pump, cuts maintenance.

Do not use turbine pumps in sandy or muddy wells; the close-running clearances wear fast. When put on a new well clear the water by hand pumping before turbine pump goes into service.

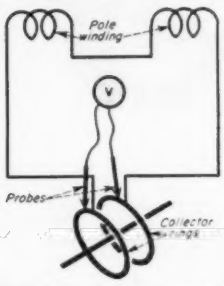
Other Applications. Turbine pumps are also widely used for handling liquefied petroleum gases like propane and butane. They are built of stainless steel for chemical and food-processing plants. Here they handle acids, alcohols, solvents and dissolved caustics. They succeed in filter presses, in hydraulic elevators. In coal mines they remove corrosive mine waters, dust sprays.

PUMP-CAPACITY TIPS

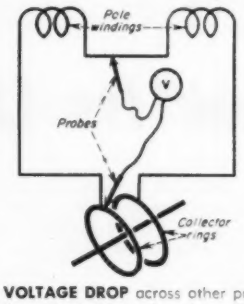
Capacity and head of a centrifugal pump depend on its speed, impeller diameter and width. At constant speed, capacity decreases as head increases. Capacity varies as the impeller's speed; head varies as the speed squared, and power input as the speed cubed.

1 **TEST EQUIPMENT** consists of a multirange ac voltmeter, an ac ammeter, two sharp steel probes and an ac power source. Use the probes as they're shown here

IMPEDANCE TEST PICKS OUT THE POLE THAT'S SHORTED



2 **READ** line voltage across collector rings, using voltmeter and probes



4 **VOLTAGE DROP** across other pole is found by touching the other collector

Fast Test Spots Shorts

Ac-generator rotor shorts won't worry you once you learn how to put this test to work. Voltmeter and ammeter do the trick

By E F MERRILL and B FRICK
Ac Engrg Dept, Westinghouse Electric Corp

► SHORTS BETWEEN TWO TURNS in ac-generator rotor windings sneak up on you in a hurry. Hard to find, they can give you plenty of trouble. New rotors don't have shorts when they leave the factory. They should be kept that way. Use this easy, low-cost test to find turn-to-turn shorts in your ac generators.

Winding Construction. All modern generator rotors have windings made of concentric coils of edge-wound copper strap. Before being insulated, straps are cleaned and filed to remove dirt, grease and burrs. Coils are then insulated between turns by mica strips on each surface.

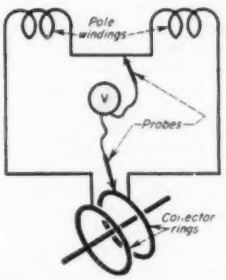
After insulation, coils are put in radial slots of machined rotor. Slots are lined with moulded-mica slot cell for ground insulation. Special pressing tools push winding into place.

When in place, all windings are treated with varnish. Afterwards, they are baked. Aluminum slot wedges are driven into the slots with an air hammer when baking ends. Rotor is ready for retaining-ring assembly and machining of bearings when blocks for end windings are wedged and fitted.

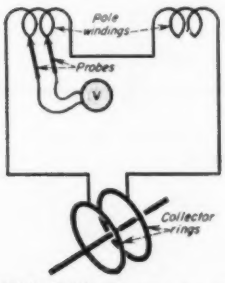
How Shorts Start. Because of careful assembly, shorts are few and far between. However, metal particles do occasionally get into the windings in the final stages. After the generator goes on the line, the continuous pressure developed at operating speeds may cause trouble. Such trouble may crop up if developed pressure causes these particles to puncture turn-to-turn insulation, shorting out a coil.

What Shorts Do. Shorts in windings can throw magnetic paths through rotor out of balance. Then rotor vibrates. Or you may have unbalanced heating. Two-pole rotors don't vibrate much from unbalance because there's only one mag-

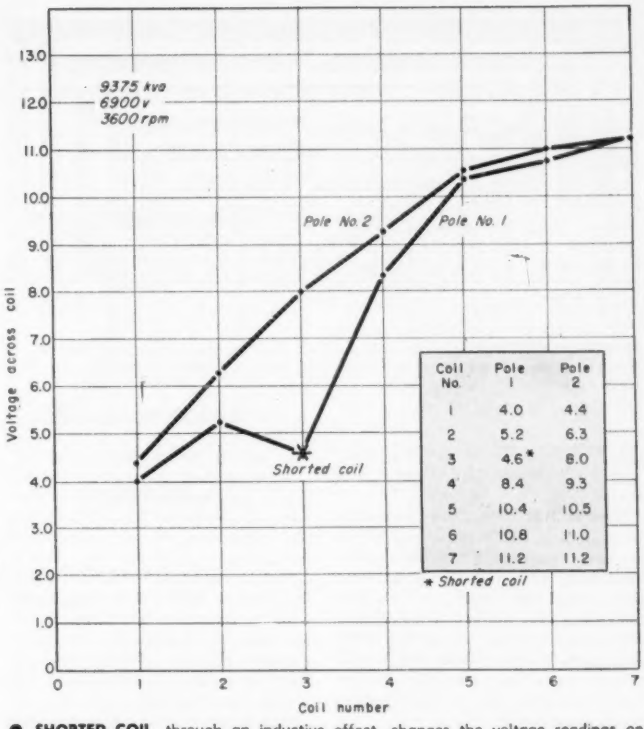
PROBE THROUGH INSULATION TO SPOT SHORTED TURNS



3 **FIND** the voltage across one pole by using the probes as shown here



5 **HERE'S HOW TO** find the voltage drop across the coils, one at a time



Coil No.	Pole 1	Pole 2
1	4.0	4.4
2	5.2	6.3
3	4.6*	8.0
4	8.4	9.3
5	10.4	10.5
6	10.8	11.0
7	11.2	11.2

* Shorted coil

6 **SHORTED COIL,** through an inductive effect, changes the voltage readings on the nearby coils. But coil with the greatest voltage difference is the shorted one

in Ac Generator Rotors

netic path. Shorted turn or two only affects total ampere turns of magnetizing force. But you can have severe vibration with 4- or 6-pole rotors.

You need a large number of shorts to get enough unbalanced heating to bow a large rotor. On most jobs we've seen there is so much iron with such a large surface area that heat is lost fast.

Why Test? A few shorted turns in a rotor won't give you any operating headaches. So you don't need high-cost test equipment. But a low-cost reliable test to find faulty windings can stop trouble before it stops you. Impedance test we use is your answer. It can be made with equipment found in most plants.

Test Methods. You might think a dc bridge is best. But bridge accuracy is limited. With 200 rotor turns four have to short with zero resistance to come within bridge reading accuracy.

You seldom run into zero-resistance shorts. Most shorts take out only ⅛ to ¼ the resistance of a single turn. You'd have to have 20 to 30 turns shorted for a dc bridge to show a definite fault.

Don't try search coils in air gap or excitation of the coils by transformer. You need special equipment and must remove retaining rings from rotor.

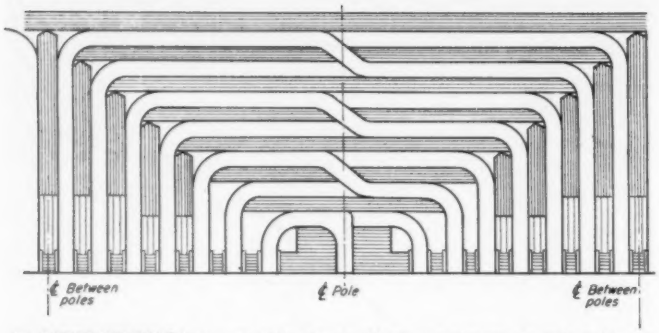
Impedance Test. This saves the day. You don't need special equipment and you can use this test, in part, with retaining rings in place. Rough checks of winding condition are made with the rotor in machine.

Think of the rotor winding as an iron-core reactor. Short in one turn cuts down over-all impedance of rotor winding. Turn acts as a short circuit on the secondary of an autotransformer. Percentage change in winding reactance is much bigger than resistance change from fault between coils of the rotor.

Test Equipment. To find rotor shorts you need a multirange ac voltmeter with 0-10, 50 and 150 v scales, a 10-amp ac ammeter, two sharp steel probes, Fig. 1, and an ac power source of 25, 50 or 60 cps at 110 or 250 v.

Make the steel probes from ⅛-in.-diameter rods ground to a fine point at one end. Insulate other ends with friction tape. Use 110 v for 2-pole rotors, 110 or 250 v for 4- or 6-pole rotors, depending on design.

Take a look at rotor winding in Fig. 7, p 132. It has seven coils per pole but you may have from four to nine, or more. Remember, each pole has same number of coils and each coil has a matching one in opposite pole. That's why impedance of the two poles should be the same. Also, impedance of inner coil of one pole should balance impe-



7 **ROTOR WINDING** has seven coils per pole. Your generator may have from four to nine or more coils per pole. Each pole has the same number of coils in it

dance of inner coil of the other pole, and so on. Match coils in order from center.

How to Test. Here's your procedure when rotor is out of stator and retaining rings removed. Excite winding by connecting ac source across collector rings. Read line voltage across collectors, using voltmeter and probes, Fig. 2. Put one probe on pole jumper and touch other probe to one collector ring to read voltage across one pole, Fig. 3. Put probe on other ring; record voltage across second pole.

With 110-v excitation these readings are two volts or less apart if rotor is free of shorts. Two-volt limit is used for rotor building; it doesn't mean rotor won't work well if difference is greater than this.

Next find voltage drop across each coil, Fig. 5. With a hooked probe, pierce the insulation on bottom of top crossover. Contact bottom crossover with other probe. Probing through insulation at bottom of top crossover leaves enough creepage distance to stop flashover through puncture to ground in high-voltage tests or faults.

Read voltage across only one coil at a time, recording it as read. Repeat these readings for other poles of rotor winding in the same way so you can compare them easily. Record line voltage and rotor current at end of test.

Test Results. This is where you find what you've been looking for. Compare voltage drops across each pole. If difference is two volts or less, you haven't any worries. With a short in a turn the difference is 4 to 12 v. Be sure to compare individual coil readings because there may be a short in each section of winding that lowers over-all impedance of each pole by same amount. Then you'll have balanced readings of two volts or less, across either rotor pole.

When one turn shorts, your reading, Fig. 5, will usually be 2 to 5 v lower than coil in opposite pole. Fig. 6 shows that voltage drops of coils near shorted one in faulted pole are less. This is caused by an inductive effect. But coil with greatest difference is shorted one.

Make a chart of voltage drops in similar coils in each pole. You should get a smooth curve when there are no shorts. When curve has a sudden break you can be sure you have a shorted coil.

Find shorted turn by making the same kind of curve for turn-to-turn readings, which are taken about the same way. Or use a dc bridge to find short and how bad it is. To get greater voltages per turn across winding, connect 110-v source across one pole that has shorted coil. This doubles turn-to-turn voltage and reduces scale error. When rotor has many small turns, the dc bridge may do better job in finding shorted straps.

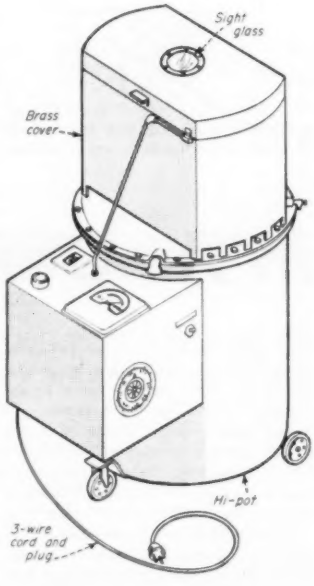
Retaining Rings in Place. You can't check many points when rings aren't out. Use probe with a right-angle bend in it about ½ in. from end. Touch bottom crossovers with probe, measuring ac voltage drops between collector ring and each bottom crossover. This measures voltage drop across two coils in series and isn't as accurate as our first test.

Here's a point to remember when making this test. Steel beams and concrete floors reinforced with steel can throw pole-to-pole readings way off. You may be as much as 10 v off when magnetic material is too near rotor. To get around this, turn rotor halfway over. Take drops across poles. If stray iron is trouble, pole that reads low first time reads high by about same amount on second test.

Record rotor impedance when in machine and out. Reactance is higher with rotor in stator. Check general condition of rotor by taking its impedance when machine is stopped. As long as impedance stays the same no new shorts have started.

If impedance of your rotor drops from one test to the next, a short has occurred. Such a short usually causes a 10% drop in 60-cycle impedance of rotor winding. Every short after this gives you a smaller impedance drop. So it's almost impossible to find more shorts by total impedance of rotor winding after six or seven have developed.

Remember that one or two shorted turns don't mean that the rotor must be rewound. The main purpose of this test is to be certain that the insulation is not deteriorating. Only if shorts begin to appear in rapidly increasing numbers should plans be made to rewind the rotor.



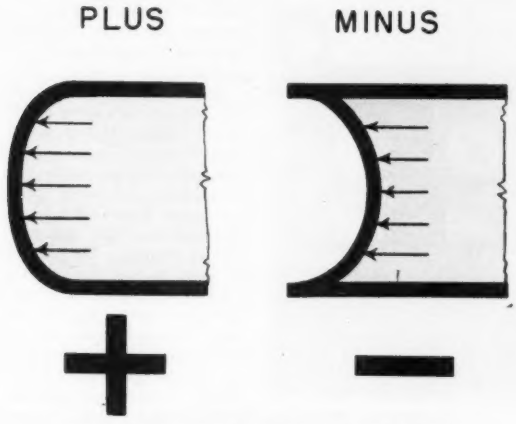
Lid Takes Shock Out of Oil Tester

Exposed-cup current drain of our 50-kv transformer oil tester gave us the willies. Our shop built the 20-ga brass lid. It has rear hinges and 4-in. bezel. Microswitch in series with power supply mounts on lid, prevents current flow with lid open. Third wire grounds unit. P C Ziemke, Oak Ridge, Tenn.

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers

—TYLER HICKS, *Assistant Editor*



FROM NOW LET'S CALL TANK HEADS PLUS OR MINUS

BY NOW the editors of POWER have found a whale of a difference of opinion on the meanings of *convex* and *concave* heads. Not even the smart boys agree on what is right.

Engineers and manufacturers fall on one side the fence or the other. But no one we wrote or spoke to went off the beam when we used *plus* and *minus* heads. So we've decided to stick our necks out, come what may.

From now on, in POWER, we'll use plus and minus, as pictured above. And we'd like you readers and manufacturers to do the same if you agree with our use. What say, aren't plus and minus better and *surer* than convex and concave? Let's hear from you.

Likes Work Schedules

POWER's readers really helped me when they sent so many answers to *WB's* question in the July issue. The lineup of work schedules (p 132, Oct POWER) gave so much dope that most any operator can now set up his own schedule.

I liked the simple schedules used by Talbott, Hein, Lane, Green and Hunnewinkel. The others are for bigger plants than mine, so I can't say as much about them.

Keep up the good work. This kind of info is really right down my alley.

L C HEARN *Chicago, Ill.*

This Feed Pump Screamed

EVERY TIME I read Marmy he brings back memories. Here's a story he'd like.

Many years back I put a steam-plant job into running order out in Denver. We had marine-type reciprocating feed pumps that were supposed to be oilless. Condensate was the lubricant.

When we put the plant on the line the feed pumps screamed in agony. It was a pitiful sound, one that really hurts a good operator's ears. I made tracks fast and threw together a small pipe lubricator. I filled it with oil, cracked the valve and sighed when the scream stopped entirely.

I've scratched my head over this many times, but my idea then, *and now*, is that wet steam condenses enough to lubricate this type pump. With superheated steam the story is different. The pump needs some oil to take the place of the moisture that doesn't form. The company brass chalked up a boner for me, but I'm still doubtful about it.

ED DUFF *Aurora, Colo.*

What do you readers think of Ed Duff's argument? Should the steam end of reciprocating feed pumps be lubricated with oil when the builder says they are oilless? Did superheated steam cause screaming of the pumps?—ED.

Whang That Ball

SOME READERS might think W H Ostrander's whanging of a ball-check valve (p 136 June POWER) is a bit of a strong-back weak-mind tale. It isn't.

For several years, while on field-service trips, I've whanged ball checks to form a new seat. Brother, it works!

Once, after making a new seat this way, the plant engineer asked me what I called my method. Right there I started to get red because I had never thought it needed a name. Our local representative answered for me, calling it "cold forging."

Now here's the best proof of all. Whanging has been so good on our jobs that we now include instructions on how to do it in our manual covering chemical-feed equipment.

E R FRANKLIN
℅ *Proportioneers, Inc.*
Providence, R. I.

NOTE: *Sounds OK, but better play safe! Use only a brass rod or other soft metal when whanging ball.*—ED.

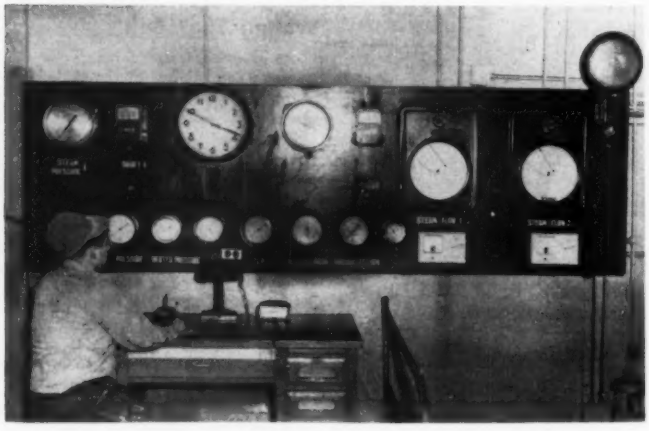
Couldn't Stop Laughing

When I read Marmaduke's story in June POWER, "Donovan Makes A 'Grate' Deal," I couldn't stop laughing. And I know the old boy's right because I spent ten years in Shanghai.

I speak Chinese and traded a lot with Chinamen. Telling them what to do and then bargaining the price down—with extra "cumshaw," is something.

R MATZDORFF *Kansas City, Mo.*

PRACTICAL IDEAS... *here's the trading post for your*



PANELBOARD PAYS ITS WAY

OUR PLANT, which has two oil-fired boilers, is fairly well metered. The meters, obtained at different times, were not well arranged, so we built a panelboard and installed them on it. We did the job with nothing more than ¼-in. brass pipe, a piece of ¾-in. plywood and fittings found in any plant.

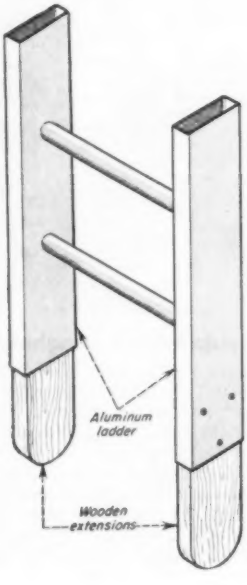
For the board we selected a well-lighted section of the plant close to the boilers and convenient for the watch engineer. After determining the number of meters and gages we would have, we sketched them to scale in the correct position on a chart. This chart showed us where they were to go on the board and their size.

We fastened the board to the wall by brackets, and left room behind it for a man to work. At this point we were ready to put in the piping, but this required careful planning to avoid obstructions. Distance between the boiler and panel was considerable so the piping had to be carefully supported to prevent it drooping. We put T-fittings at all gages to blow out and test them.

Along the top of the board are pressure gage, draft gage and steam flowmeter for each boiler. At the bottom of the board from left to right are gages for low-pressure steam lines, fuel oil, damper regulations, feedwater steam, building-heating steam; compressed air and vacuum on the building-heating return system, see photo.

Also, there is a flue-gas temperature indicator with alarm for each boiler. The alarm sounds when flue-gas temperature gets too high. It took us about a month to build the board, but the job has paid off in plant neatness, efficiency and safe operation.

WALTER TROY *Summerville, Mass.*



How to Insulate Aluminum Ladder

AN ALUMINUM LADDER is lightweight, free from splinters, and it is reliable because it does not deteriorate. But its one big fault is that it's a good conductor of electricity.

I know electrical maintenance men who have suffered annoying shocks when working with such ladders. And I've read about various accidents in industrial bulletins. Usually heavy currents pass direct to ground through the electrician's body and the ladder.

My illustration shows one way to insulate a typical aluminum ladder. Secure extension pieces of seasoned timber to both ends of its sides. This ladder has side members made from hollow rectangular section tubes. The wooden extensions are a tight fit, and each is secured in place with three wood screws. For ladders having side members of channel section material, insulate by bolting on extension pieces.

Seasoned timber is good insulation to use on ladders for indoor work and dry locations. Ladders in damp outdoor spots are best fitted with extensions made from resin-impregnated plywood, or some other synthetic material that has adequate strength.

These materials are usually impervious to water and have a low conductivity factor.

F E RILEY *London, England*

Pressurizing Cleans Surface-Condenser Tubes

HERE'S A SHORTCUT that can be used by anyone that has a divided-surface condenser. When the tube sheet starts to mat over with debris from the circulating water, close one inlet valve for about 10 sec, to raise the water pressure and velocity on the other side. The debris will be forced through the tubes and out their overboard ends. This has worked so well for us, that we do this on both sides of the condenser each week

K M WHITE *Clinton, Iowa*

operating and maintenance short cuts

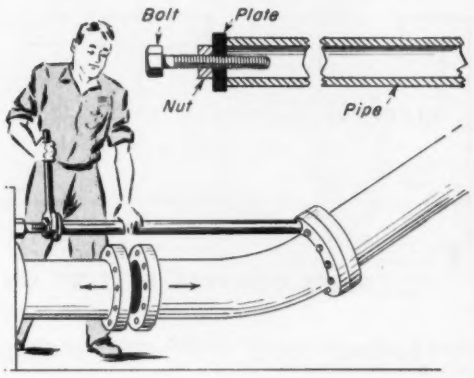
STEVE ELONKA, *Associate Editor*

HANDY JACK BAR

HERE'S A HANDY jacking bar anyone can make. All you need is a piece of scrap pipe, a standard bolt and nut, and a pressure plate. See the parts at top of this sketch.

To force pipe flanges or anything else apart, this gadget is priceless. Large washers will do for the pressure plate. Use length of pipe needed for each job, then place back in pipe rack, and use another piece to fit the next job.

FRED J ARDOLINO *Brooklyn, N. Y.*



MEASURE FOR LIQUID LEVEL

IF YOUR PLANT has tanks, vats, reservoirs, tunnels, or any type of liquid storage—even if liquid flows in open trench or tunnels, here's device to measure levels. It's simple to make, and necessary parts are usually easy to secure. You need compressed air, but amount is small.

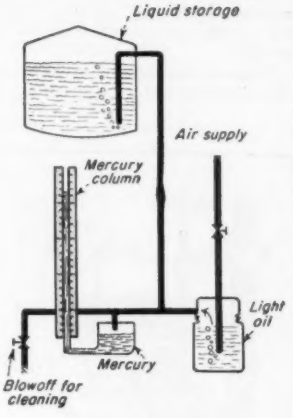
Compressed air goes to "bubbler," made of heavy glass jar partly filled with light oil. From there it's forced down into liquid to be measured. By adjusting needle valve in air supply so air bubbles slowly in "bubbler," you are certain it is bubbling up through liquid level to be measured.

Air is also connected to mercury column, calibrated in feet of water. Air pressure on mercury balances column and indicates level in storage tank.

A few cautions: If air does not bubble up through liquid in storage tank, you won't know if the line is full of air or partly flooded with water (or whatever is stored in tank). If air flow is great enough to cause a pressure increase in line to tank, gage will read high and mercury may blow out of column.

Once you set and adjust this gage, it gives dependable service. Make all tubing of ¼-in. copper, and place gage where it can be seen.

A W SHEPHERD *San Diego, Calif.*



Pressure Switch Stops Centrifugal Pump

A MOTOR-DRIVEN centrifugal pump discharged sewage sludge into a barge near the plant. Then loading had to be changed to a dock about ¼ mile away. A discharge line was run from the pump to the dock, but no means was provided for communication between pump and dock. We had to shut down the pump when a barge was loaded. So we had to know when the dock man closed the discharge valve.

Instead of having a man watch the pump's discharge pressure gage we used a pressure switch. This we connected into a tee into the pressure-gage line. Now when the dock man closes the discharge valve, increased pressure at the pump opens the pressure switch and stops the pump.

The dock man starts the pump after an empty barge is placed and the loading hose connected.

FRED J ARDALINO *Brooklyn, N. Y.*

Recording Thermometer Keeps Tabs on Bearing

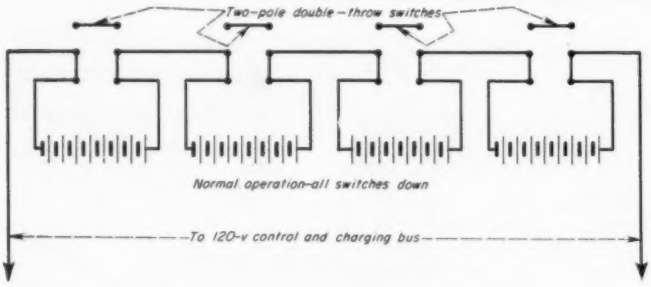
SOMETIMES a hot bearing is not detected before its metal is damaged. This happened on our engine's main bearing. When it was repaired we screwed a direct-reading thermometer into its cap. This thermometer operated an electric alarm if the temperature went too high.

One day the bearing got hot so fast that its metal was injured before the alarm sounded. This time when the bearing was repaired we bored a horizontal hole in the shell just below the babbitt, where loading is heaviest. In this hole we placed the bulb of a contact-making recording thermometer and connected it to an electric horn.

This hookup gives a record of bearing temperature at all times to guide the operator. If the bearing gets hot quickly, the alarm sounds before any damage is done.

H P CLEARY *Atlanta, Ga.*

(*Continued on page* 136)



KEEPS CONTROL BATTERY ON JOB

After several years' service individual cells in a control storage battery fail and must be removed for overhaul or replacement. This usually means interrupting the switch tripping circuits for several minutes, which should be avoided.

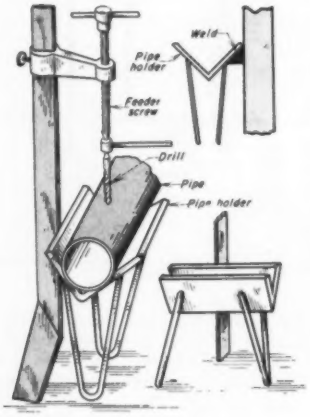
Diagram shows how we connected our 60-cell control battery so a cell can be taken out with the battery open for only an instant. Battery is divided into four 30-v sections and connected to double-throw double-pole switches. Top contacts of each switch are connected while the bottom contacts connect to a battery section.

When the switches are closed down, all battery sections are in series across 120-v bus, to which the control circuits and shunt-type charging generator connect. If a cell has to be removed from a battery section, we first take the charging generator off the bus and then close the defective-battery-section switch to the up position.

This cuts the battery section out, but leaves three sections connected to the bus. These sections give us about 90 v for the control circuit, which will either trip or close a circuit breaker. We are, therefore, without control power for only the time that it takes to throw the switch to the up position.

When the cell is removed and the opening in the battery section jumpered, the section switch is again closed down. This takes only a few minutes. The charging generator is put in service and its voltage adjusted to trickle-charge the battery at the desired rate. We have removed as many as four cells at one time and been able to keep power on the control circuit without interrupting service.

J A Coulden *Hamilton, Ont.*



Drill-Rig Taps Fuel-Oil Line in Place

We had to connect six ¾-in. lines into the discharge of our fuel-oil pumps. We did the job one Sunday when boilers were shut down. While we could have cut the holes with a torch and welded in the connections, we did not want to risk starting an oil fire with the welding torch. So we decided to drill and tap holes for the connections.

During the week we made the pipe-drilling rig, left-hand drawing. Construction details are shown on left. We made the equipment easily and it was ready for the drilling job on Sunday.

Drilling tool was placed below the pipe, which was 30 in. off the floor. First, we located hole centers with the feeder screw, then prick-punched and drilled for a ¾-in. pipe tap, left-hand drawing. Drill was turned by a ratchet while being fed down by the feed screw.

Feed screw was located so its axis passed through the pipe's center. This was done to drill the holes radially at right angles to the pipe.

G Amador de los Rios *Havana, Cuba*

Nut Stops Duplex Boiler Feed Pump

One morning the fireman told me the boiler-feed pump had stopped and he could not get water into the boiler. It is one of two duplex steam pumps. They are in the basement of the engine room, which is poorly lighted.

I tried to start the pump, but it would not budge. Then I discovered the trouble. A nut had dropped in between the piston rod collar and the rocker arm that operates the valves. When the nut was removed operation was normal.

I could not find out where the nut came from. Its falling where it did at the right instant to get caught only added to the mystery. They say that anything that can be made to happen can happen accidentally. I guess this is just one of those unusual accidents.

O M Roberts *Lynchburg, Va.*

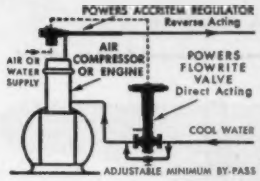
Wrong Transformers Cause Low Load

Two new units were installed in an old hydroelectric plant. When these were put into service their generators would take only about two-thirds' load even when the turbine gates were full open. As they were operating smoothly we decided to let them run awhile, until we discovered what was wrong.

One day when going over the switchboard connections with the generator-builder engineer, we found the instrument transformer had a wrong ratio for the meter calibrations. New transformers were installed and generator load checked with turbine-gate position.

Chas A Armstrong *Chicago, Ill.*

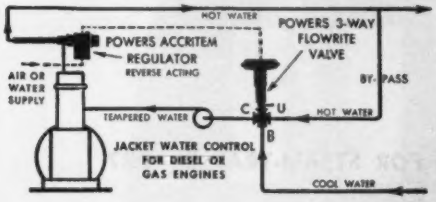
(*Continued on page* 138)



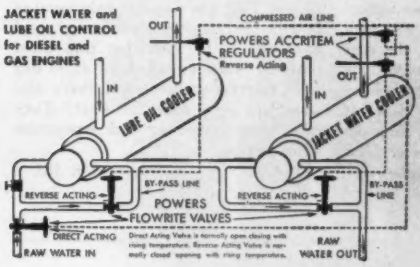
POWERS

ACCRITEM REGULATOR

Unsurpassed for reliability and power to operate large or small size 3-way or 2-way diaphragm valves for accurate control of jacket water and lube oil cooling temperatures.



Only a few of many applications are shown here.



Gives Accurate, Low Cost Heat Control

Use Accritem Regulators to control diaphragm operated valves or dampers. They save labor, stop losses caused by over-heating and have the following—

IMPORTANT ADVANTAGES

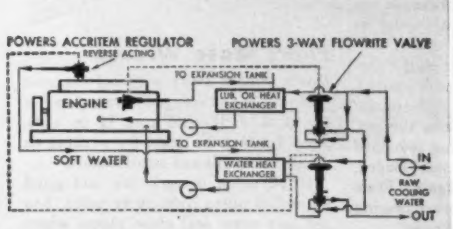
- ***Adjustable Sensitivity*** and over-heat protection.
- ***Calibrated Dial*** temperature adjustment.
- ***Simple, Rugged Construction*** withstands vibration and insures many years of reliable service.
- ***Temperature Ranges*** 50 to 250° F. and 150 to 350° F.
- ***Easy to Install*** Requires 15 lb. supply of compressed air or water for its operation.
- ***Small Size***—regulator head is only 2⅞" x 3⅝", sensitive bulb is 12" long with ½" I.P.S. connection.

Proper Cooling Temperatures assured by Powers Accritem Regulators

• Makes ignition easier • Prevents rapid breakdown of lube oil • Decreases cylinder and piston ring wear • Reduces danger of piston siezure • Lowers fuel and lube oil consumption

POWERS

FLOWRITE and METAFLOW Diaphragm Valves controlled by a POWERS ACCRITEM HEAT REGULATOR provide an unbeatable combination for *better control and lower maintenance*



Write for Bulletin 316—or phone our nearest office for prices and further information about POWERS ACCRITEM regulators and diaphragm valves.

THE POWERS REGULATOR CO.

SKOKIE, ILL. • OFFICES IN OVER 50 CITIES • See Your Phone Book

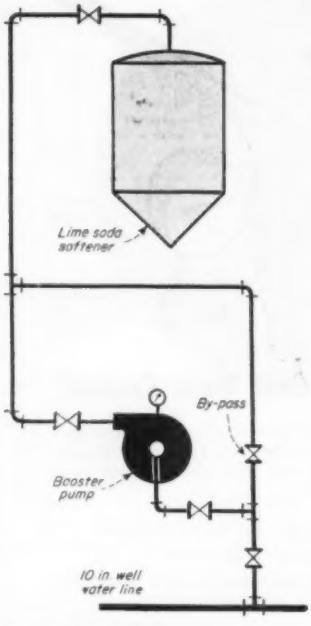
CHICAGO 13, ILL., 3819 N. Ashland Ave. • NEW YORK 17, N.Y., 231 E. 46th St.
LOS ANGELES 5, CAL., 1808 West 8th St. • TORONTO, ONT., 195 Spadina Ave.
MEXICO, D. F., Apartado 63 Bis.

AMD

60 Years of Temperature and Humidity Control

More PRACTICAL IDEAS

Begins on page 134



Booster Pump

THE WELL PUMP that served all our mill requirements was adequate before the old plant shut down. But after rebuilding the power plant and doing some extensive mill remodeling, it proved inadequate for increased process demands.

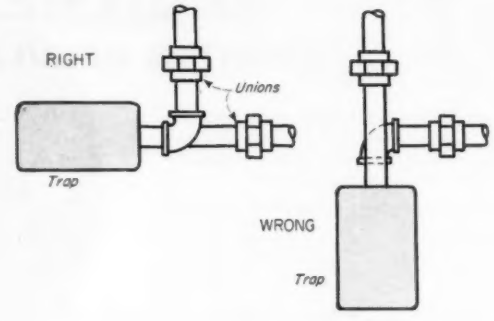
Pressure at times dropped as low as 15 psi, with 40 psi being about normal. At times, when the pressure dropped below 25 or 30 psi, we had trouble getting enough water into the softener, which furnishes the makeup for our 55,000-lb-per-hr boiler. Once we had to remove load from boiler to regain water level in the softener.

After this, our chief engineer unearthed a pump and motor lying idle in the mill-wright shop. He connected it up as shown in sketch. Motor is 5 hp. Pump is rated 100 gpm at 104-ft head and 3460 rpm. This pump was larger than we really needed, capacity of the softener being 1600 gph, but since it was handy we used it.

After pump was started up, we had no further trouble in holding water level in the softener. At least 60 psi could be had at all times. Pressure is regulated by adjusting the bypass valve and letting a certain amount of water circulate.

We now use this pump as a standby, for our antique well pump has been replaced with a new one that has ample capacity for all present needs.

J C FISHER *Middletown, Ohio*



HOW'S THIS FOR STEAM-TRAP ERROR?

IN CONNECTING the return line of a newly installed unit heater, a trap draining a heating main was temporarily disconnected. After job was completed and trap reconnected, the condensate backed up in heating main. This was puzzling since trap had merely been disconnected by opening a pair of unions. It seemed impossible to make a mistake in reconnecting it, especially since its hookup included an elbow.

But we did make a mistake. The trap had been reconnected in reverse, as shown. This was possible only because lengths and positions of fittings used happened to be such that trap fitted perfectly when turned down at 90 deg from original position. And that's just what had been done. So what? Take care when connecting such equipment after repairs.

T TRAIL *Catonsville, Md.*

Faulty Thrust Bearing Burns Out Main Bearing

A 600-KVA steam turbine-generator was operating overloaded, while a larger machine was being overhauled. One night the plant operator phoned that a bearing had burned out on the turbine. I went to the powerhouse because the machine had to be back in service as soon as possible.

Smoke was still coming from the governor's main bearing when I arrived. We removed the turbine rotor and installed a new bearing. When the machine was started the bearing remained cool until the generator was loaded, then the bearing heated again. From this we decided that the thrust bearing must be the cause of the trouble.

When this bearing was opened several rings were found broken. A new bearing could not be obtained without considerable delay. We then got a large piece of bronze from a nearby foundry and made a new bearing. After this was installed and correctly adjusted the machine went into service without any trouble.

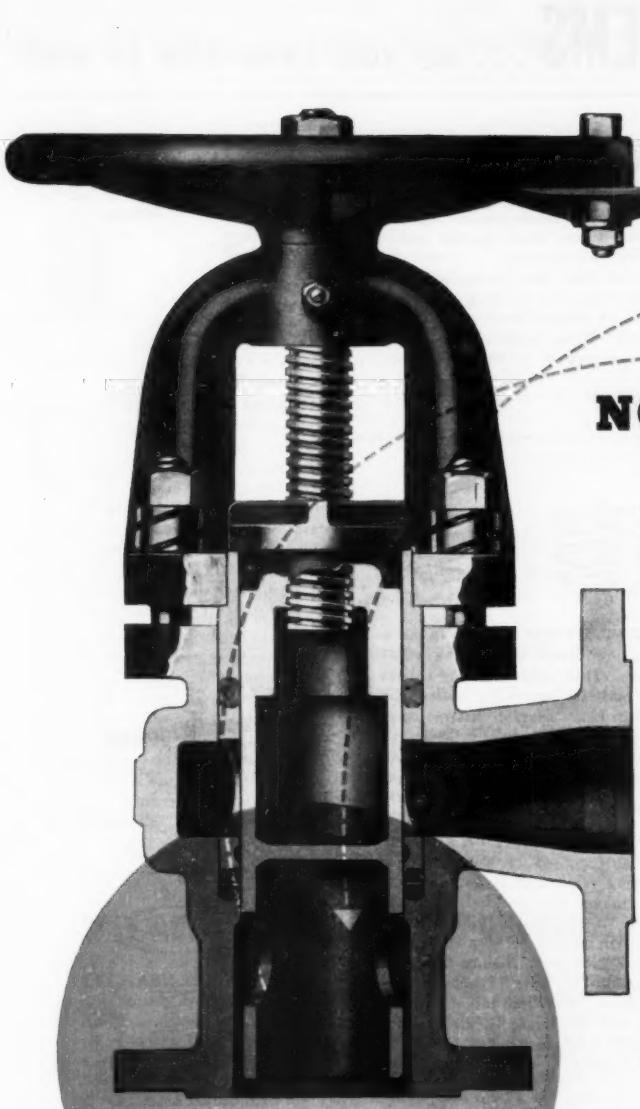
C O DIBBLE *Boston, Mass.*

Pliers Make Wrench

DON'T THROW AWAY your old diagonal pliers. They make good wrenches for No. 3, 4, 8, 10, and even ¼ in. nuts. They are just the ticket for working on all electric drills and small motors.

Grind notch in each jaw and grind off end of pliers right up to notch. You get into some real close places where you can't work with anything else.

N G NELSON *Aurora, Ill.*



Yarway Type "B" Seatless Blow-Off Valve shown in closed position.

WHAT?

NO SEAT?

That's right! In this Yarway Blow-Off Valve there is no seat to score, wear, clog and leak.

The unique balanced sliding plunger design eliminates a common cause of blow-down valve trouble—the seat. Many boiler shut-downs are saved . . . power interruptions avoided . . . production speeded.

Latest metallurgical improvements also make Yarway the ideal blow-off valve for difficult service where acid washing is used.

Yarway Seatless Blow-Off Valves are available singly or in tandem combinations for all pressures up to 1500 psi. For higher pressures up to 2500 psi, specify Yarway Stellite-seat valves.

For the latest information on blow-off valves, get Yarway's newest catalog—B-424 for pressures to 400 psi, B-433 for higher pressures.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY

BLOW-OFF VALVES

STOP BLOW-DOWN TROUBLES—KEEP BOILERS ON THE GO

PLANT PROBLEMS . . . *put your know-how to work*

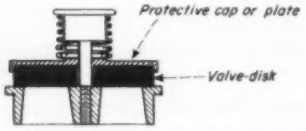
WHAT CAUSES PUMP VALVES TO WEAR?

HERE ARE THE FACTS: Our simplex horizontal vacuum pump handles condensate returns from our steam heating system. Eight months ago we put in four new suction valves, seats, springs and stems. Pump ran well at first, but then lost capacity.

We opened pump and found all four suction valves worn (photo, p 134, Sept *Power*). There was a slot about 1½ in. long and ¾ in. wide worn from stem hole to edge of composition valve disk. Sides of slot are smooth and vertical without pits or grooves.

What caused this wear? How can we stop it in future?—*VH*

HERE ARE THE ANSWERS



PROTECT DISK. Wear comes from using composition disk without protective cap or plate. See sketch above. Also, if wrong disk material is used it will wear faster. See pump manufacturer for best disk material and cap type.

ART CANNON
Laurence Harbor, N. Y.

WATER CIRCULATION in valve chamber could set up unequal forces on valve disk. Direction in which force acts can be found by looking over slot worn in disk. If pump worked right at start, water circulation probably isn't cause of trouble.

Check to see that studs are perpendicular to valve seats and that springs bear evenly on valve disks.

IRA A BUTCHER *Cincinnati, Ohio*

TOO MUCH TENSION on valve spring causes disk to tip. It strikes stem and wears. If stem is too long, wear will be speeded.

Back off on stem to reduce tension, or buy disks with brass center inserts.

W G STINSON *Regina, Can.*

WRONG DISKS. *VH* probably took out the original valve disks and matched them up with something that looked as if it would do. Instead, he should have reseated the original disks or replaced them with ones of the same material.

I think a soft-rubber disk was used to replace a metal disk. This seldom works. For best results replace with same type and material.

A M PALMER *Brooklyn, N. Y.*

WRONG SPRINGS. It looks to me as if wrong replacement springs were used in pump. They were probably cut off at the ends for shortening without being flattened or beveled before use. So pressure on valve disk is uneven.

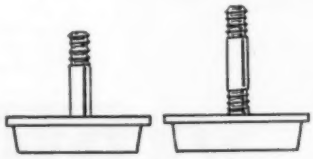
Sketches above show right and wrong ways of cutting and beveling springs.

E D DEWHURST *Spokane, Wash.*

TRY CIRCULAR RIBS. *VH's* trouble is probably caused by water and vapor striking valve disk at an angle. Disk tilts against stud and hole is worn.

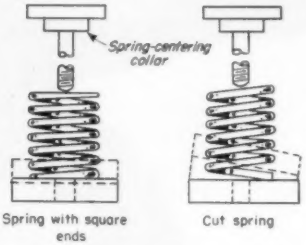
Use deep valve-seat ribs. Fit a circular rib midway between stud and outside of valve seat. Reduce thickness of other ribs so valve capacity won't be cut down. Seats like this deflect water so it hits disk squarely, giving straight lift and reducing wear.

P KNIGHT *Toronto, Can.*



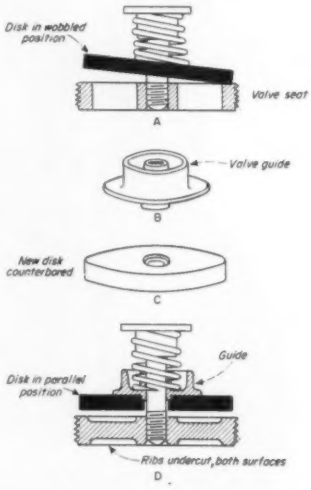
CHECK THESE. Look for (1) stems not screwed all the way into seats, (2) disks that are too soft. Sketch shows right and wrong way of screwing up stems. I like bakelite-type disks for long service on heating-system pumps.

ARTHUR HOLT
Atlantic City, N. J.



HAD SAME TROUBLE. One of our simplex vacuum pumps gave the same trouble. Cause was found to be the valve springs. Don't cut springs from a continuous coil. Never cut long springs to needed length; use right length at start. Sketches above show how springs with square ends give uniform pressure on valve and reduce wear. Be sure to use spring-centering collar on stud.

R E FONTAINE *Kenmore, N. Y.*



DISK WOBBLES. Improper seating causes uneven wear of disk. When stem hole enlarges, condensate leakage gets worse and pump loses capacity.

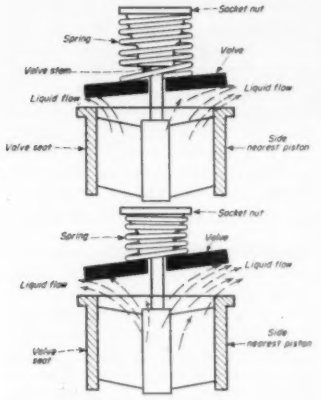
Sketch *A* shows disk in wobbled position. To prevent wobble, machine a soft-metal guide, sketch *B*. Counterbore disk for new guide, sketch *C*. Then machine valve ribs below both surfaces as shown in assembled view, sketch *D*. This will cure trouble *VH* has had.

A J BREUGELMANS *Hoboken, N. J.*

For Your New Problems, see page 142.

help the other guy cure his headaches

TYLER HICKS, *Assistant Editor*



SPEED TOO HIGH. *VH* may be running his pump at too high a speed, cutting the time for right valve action. Running at high speed causes water to move through pump faster. Side of valve nearest piston is lifted first, as in top sketch, when water velocity is too high.

If pump discharge pressure is too high, valve disk may hit bottom of socket nut as in lower sketch. Both conditions can cause slot wear.

Replace present valves with bronze ones. Run pump at normal speed.

D J PARMER *Quincy, Fla.*

WIREDRAWING. It looks to me as if there is wiredrawing between the central hole and valve stud. This means disk is too soft or valve spring tension isn't adjusted right. To have wiredrawing, condensate must be forced through hole at high velocity. With right spring tension, valve would open before this happened.

Best cure is to replace valves with ones of right material and adjust springs. Have enough tension to just close valve. Don't allow valve to lift more than ¼ of diameter of valve opening.

HAROLD E ALEKNA
Brownsville, Tex.

PUMP PLUGGED. Stems wear valves because there's plugging of some sort in pump or pipes. Make a complete check of pumping system to find trouble cause.

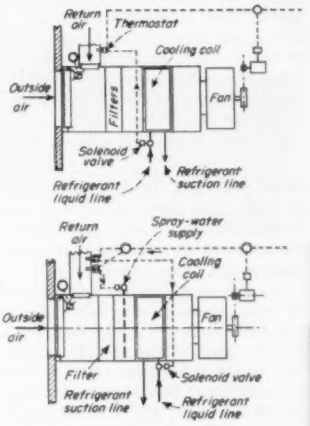
CLYDE G HOWARTER *Canton, Ill.*

UNEVEN SPRING TENSION. Disk is slanted when pump pulls water. Central hole is pushed against valve stem, causing uneven wear.

We cured similar trouble by fitting a brass plate on top of disk and beveling spring starting coils so vertical lift was uniform.

VINCENT STROJSA *Glace Bay, N. S.*

Another Answer to August Question Where Can I Use Solenoid Valves?



TRY THEM HERE. Solenoid valves find uses in air conditioning, refrigeration, oil and gas burners, and on a multitude of other jobs. Sketches show solenoid valves in cooling system and winter humidification system. Accurate control is obtained with little attendance or maintenance.

C A WILKES *Oaklyn, N. J.*

WHY ARE LOADS ON MOTORS UNEQUAL?

HERE ARE THE FACTS: In our plant we have three 75-hp induction motors driving a lineshaft (sketch, p 134, Sept *Power*). When motor *A* carries entire friction load it draws 47 amp per terminal; when *A* and *B* operate together on friction load, *A* draws 42 amp per phase. With all three motors on friction load *A* takes 35 amp. When all motors drive full load on shaft, *A* takes 135, *B* 85, and *C* 75 amp. Motors operate on a 3-phase 60-cycle 440-v system.

I'd like to know why motor *A* takes more load and runs at a higher temperature than either of the other two. What can we do to balance load between motors?—*PR*

HERE ARE THE ANSWERS

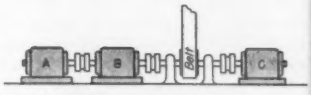
INTERNAL FAULT. *PR* has most likely looked into belt and pulley troubles that may be causing overload. From there he should go to internal troubles.

Motor *A* may be connected wrong. Then this motor may have been rewound at one time or regrouped from delta to star. Check for these changes.

CARL BACHMANN *Rego Park, N. Y.*

REPLACE MOTOR. Motors *B* and *C* seem similar enough to use together. Replace *A* with a motor identical to *B* or *C*. If this can't be done, characteristics of *A* can be made the same as *B* and *C* by removing some rotor end rings or cutting out some rotor bars. We've done this on a number of jobs.

HOWARD DAVIES *Philadelphia, Pa.*



WRONG SETUP. *PR's* arrangement is one way motors should not be used. Slight differences in pulley ratios, synchronous-slip characteristics of motors, tightness or adhesive quality of belts cause serious unbalancing of load.

Solve thus: (1) Divide lineshaft system into three parts with one motor to drive each part. (2) Use individual motor drive on every machine. (3) If present motors are all same make and model, replace belts with chain drives or use setup in sketch. (4) Or replace three motors, now used, with one large one. This scheme has been used in several plants with good results.

ARTHUR HOLT
Atlantic City, N. J.

For more answers to this problem on motor loads, turn to page 142.

More PLANT PROBLEMS

Begins on page 140

FULL-LOAD SPEEDS are unequal. Difference is only a few rpm and results from problems met in motor building. Test to see which motors run at higher speed. With a hacksaw cut a narrow slot in end ring of higher-speed motor or motors. This increases end-ring resistance slightly, causing motor speed to fall a few rpm. Adjust slot width until all motors run at same speed.

C E PHILLIPS *Wilkes-Barre, Pa.*

FAULT NOT ELECTRICAL. *PR's* trouble probably isn't electrical, because none of his motors have burned out. His best bet is to look for trouble in the power-transmission units. Check these:

(1) Bearings of motors *B* and *C* may be worn, causing loose belts. (2) Or lineshaft bearings over motors *B* and *C* may be worn, allowing shaft to drop. This would loosen belts, too. (3) Driving pulleys may be unevenly worn, made of different materials, or have unequal diameters. This may also be true of the driven pulleys. For best results have all pulleys of same type and material, and of proper diameter for their job.

(4) If shaft of motor *A* isn't parallel with lineshaft, belt may be tighter than it should be. (5) Angle of inclination of all belts may not be the same. (6) Check to see that belts are the same type, age, make, and matched for length and elasticity. (7) See that motor and lineshaft are exactly parallel for each drive.

Cure with a weighted idler on each belt. Figure weight so that amperes drawn by all motors are same at no load. Load shaft, and check amperage again. Values should be equal but they will be higher than at no load.

E T STEVENSON *Takoma Park, Md.*

LINESHAFT GIVES. There may be slight give in lineshaft and flanged couplings under load, causing unbalance. If pulleys are connected to shaft by friction clutches there may be slip in them.

If this were my plant I'd start by making a complete check of the motors first to see they run right. After that I'd check the power-transmission units.

HOWARD LIVINGSTON
Los Angeles, Calif.

DIRTY WINDINGS. Look over windings to see if they are dirty. Clean with a nonflammable solvent, then blow out with compressed air.

ALBERT H MOULTON
Pittsfield, Mass.

SOME CHECKS. Fine speed of each motor at no load and full load. If speed for all motors is the same at the same load, check pulley diameters. All driving and driven pulleys must have right diameter if loads are to be equal. If speeds and diameters check out right, switch driving belt from motor *A* to motor *C*. Belt used on motor *A* may have greater adhesion than that on *C* so *A* carries more load. Or shaft nearest motor *A* may be carrying heavier load.

VINCENT STROJSA *Glace Bay, N. S.*

CHECK VOLTAGE. Measure voltage at terminals of motor *A* when it's running. Low voltage could cause motor to draw excessive current when loaded. Current used by *A* shows much overloading, which is cause of high temperature.

NORTON SAVAGE
St. Clair Shores, Mich.

MOTOR INEFFICIENT. Motor *A* has a lower efficiency than *B* and *C*. There are several possible causes of this. Worn bearings, rotor rub, dirty windings and low voltage should be checked.

IRA A BUTCHER *Cincinnati, Ohio.*
D J PARMER *Quincy, Fla.*

CHANGE BELT TENSION. Raise or lower motors, taking readings with an ammeter until each motor carries one-third of load. *A* now takes nearly half the total load. Raise it by shimming until belt slippage causes transfer of some load to *B* and *C*.

A is taking more load because its belt is tighter or it's closer to shaft load. Overheating is caused by overload.

ARTHUR F JONES *Miami, Fla.*

CONDITION ISN'T SERIOUS unless motor *A* gets too hot. With slipring motors put a resistor in each line of rotor circuit. Pick it so load is cut to a safe one.

Get advice from motor builder before putting a resistance in rotor circuit of squirrel-cage motors. (NOTE: *This is a mighty tricky surgical operation; don't try it unless you know exactly what you're doing.*—EDITOR)

If *PR* wants to spend some money he can use an autotransformer or induction regulator to kick speed of motor *A* down. Use with squirrel-cage motors. No matter what *PR* decides to do he should see motor builder first.

C O 1*& DANNENBERG *Brooklyn*

For more answers, turn page

YOUR NEW PROBLEMS

1 How Can We Stop This Tank Trouble?

We have a 15,000-gal underground tank for fuel-oil storage buried back of our boilerhouse. Trucks deliver No. 6 oil, unloading 4250 gal at each trip.

Lately we've noticed a resistance or soft cushion every time we drop a measuring rod to tank bottom. We think we have several inches of sludge on tank bottom. Tank doesn't have a drain, so we're scratching our heads trying to find a way to get rid of sludge.

We tried an emulsifying oil to thin sludge. This was put in with every truck load of oil but we still have the sludge.

How can we remove this sludge? Is pumping OK? Should sludge be heated before being pumped? Can we burn it under our boilers? If not where can we dump it?—*AHP*

2 How Can We Control Compressors?

We have three Freon refrigeration compressors that serve three separate cooling loads on one floor of our plant. Sometimes load becomes unbalanced, one area being cool, others being hot. There's no way of running the compressors so they help each other.

Since total refrigerating capacity is more than enough to handle load we've been wondering if a common header on high side would give flexible control. Is a common receiver also needed? What are advantages of this method? Is there a better way of hooking up these compressors?

We installed units individually because local ordinances required a licensed operator. We now have one and can run plant as needed.—*RN*

Will you help readers who sent us their problems? Extra pay for photos, sketches.

In Plant After Plant—

One of America's Largest Auto Manufacturers Has Selected MULTICLONES for Fly Ash Recovery!

Over 35 MULTICLONE Units To Date in Various Plant Divisions!

A Few of *Many* MULTICLONE Advantages!

POINT 1 —It Saves Space!

Plant space costs money. Because the Multiclone makes *really important* savings in space, it makes similar savings in plant costs. The chart tells only part of the story because, in addition to being far more compact both in square and cubic footage, the shape of the Multiclone can be adjusted to fit various space requirements—either long and narrow, short and wide, or square. You can often fit the Multiclone into tight spaces or waste areas too small for other equipment!

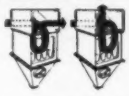
Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

POINT 2 —It Recovers the "Fines"!

Because its exclusive vane design and small diameter tubes generate higher centrifugal forces, the Multiclone recovers a large percentage of even the very fine particles 10 microns and less as well as the heavier particles. Multiclone's high recovery of both small and large particles means high overall collecting efficiency.

POINT 3 —It is Unusually Adaptable!

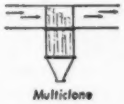
In addition to the shape adaptability outlined above, Multiclone's inlet-outlet connections are also readily adaptable to plant restrictions. Where headroom is low, install the Multiclone with side-inlet, side-outlet. Where side clearances are small, use side-inlet, top-outlet arrangement. Or still other arrangements are possible!



POINT 4 —It is Simple!

Both installation and maintenance of the Multiclone are unusually simple. For example, the Multiclone requires only a *single* inlet and a *single* outlet duct compared with the complicated multiple ducts of conventional cyclones. This not only saves space—but is simpler and cheaper to install and insulate. Moreover, the Multiclone has no filters to replace, no high-speed moving parts to maintain, nothing to require frequent cleaning or repair . . . and a *single* collecting hopper serves many tubes!

Conventional Cyclone



Multiclone

POINT 5 —Still Other Advantages!

The above advantages are by no means the complete story on Multiclone savings. Get *all* the facts before you decide on *any* recovery installation.

Send for this Multiclone booklet!

COTTRELL PRECIPITATORS · MULTICLONE COLLECTORS · TURBULAIRE SPRAY DRYERS

YEAR AFTER YEAR—in plant after plant—one of the nation's largest automobile manufacturers has selected Multiclone Collectors for recovering fly ash and dust in its many manufacturing divisions. This repeated selection of Multiclones—now totalling over 35 units—is high testimony to the many vital advantages found in Multiclone equipment. Check over some of these advantages as outlined at left . . . advantages that will save space—cut installation costs—boost recovery efficiencies—minimize maintenance and make other important savings on *your* recovery operations, too.

Then consider this fact . . . Any *one* of these advantages is sufficiently important in itself to make Multiclone equipment the logical choice for your recovery operations. But when you realize that the Multiclone offers definite, clear-cut advantages on *every* qualification essential to maximum efficiency and economy in recovery operations you have some idea of the far-reaching savings you will make by installing Multiclone.

Let us give you further information on Multiclone recovery equipment. A letter, wire or phone call to our nearest office places the information in your hands without obligation. Get *all* the facts—and you'll get Multiclone!

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1049 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
CHRYSLER BLDG., NEW YORK 17 • 1 LaSALLE ST. BLDG., 1 N. La SALLE ST., CHICAGO 2 • HOBART BUILDING, SAN FRANCISCO 4, CALIFORNIA
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

More PLANT PROBLEMS

Begins on page 140

WORN BEARINGS. Check air gap between rotor and stator of motor *A*. Use feeler gage. If clearance isn't uniform at all points, replace motor bearings.

Or winding insulation may be damaged, shorting coil. Look for a grounded winding. Use megger for these tests.

Rotor bars of squirrel-cage type rotor may be loose. *PR* will see sparks between bars and end ring while motor is running if this is so. Growler can also be used to find loose bars.

JOHN P MULVEY *Yonkers, N. Y.*

WRONG PULLEY. It might be that a drive pulley of wrong size was put on motor *A*, either during an overhaul or when job was installed. Replace with one of right size.

I don't think *PR* has gone far enough with his tests. Set up a few known test loads and check with ammeter and tachometer. If trouble can't be found look into power supply and belt drive.

A M PALMER *Brooklyn, N. Y.*

CHARACTERISTICS DIFFERENT. *PRs* trouble may be from different torque-speed characteristics of the three motors. Some alternating-current motors can run at same speed but draw unequal currents. Even with three identical motors small voltage differences caused by unequal size or length of leads might give you operating troubles. Stop by equalizing lead resistance. Flat-belt slip isn't enough to account for difference in load.

C B SCHUDER *Grand Tower, Ill.*

BELT SLIPS. Power from induction motor varies inversely as speed. Since line-shaft speed for three motors is the same, speed ratio of the drives must be different. Too much belt slip in *B* and *C* or slight differences in pulley diameters could change speed ratios. If belt slip isn't the answer, reduce diameter of drive pulley on motor *A* until its speed equals that of other two motors.

R T MORGAN *Lunenburg, N. S.*

TWO CAUSES. I see two causes for *PR's* trouble: (1) motors have slightly different slips (2) speed ratios are different for one or more motors.

Motor *A* runs with more slip than it should have at 75 hp. Increase motor speed by grinding motor pulley to reduce its diameter about 1%, or less. If motors have different slips, grinding motor pulley will balance only full-load output. Current will still be unequal at part and no load.

J J DERAEMY *Schenectady, N. Y.*

POWER FACTOR DOWN. Motor *A* hogs the load. When operated with *B* it pulls less amperes than when running alone. Also, power factor of *A* falls with load, but current stays about the same. With wound-rotor motors, brush resistance can affect load balance.

If brushes cause unbalance, put higher resistance ones in motor *A*. Do this as soon as possible because a burnout is expensive these days.

ALBERT R ECKERT *Mt. Vernon, Ill.*

SWITCH MOTORS. After motors are switched, see if current readings are same as they were. Look for poorly soldered connections to motor, high-resistance grounds or partial-open circuit. Check for faulty starter contacts.

C G HOWARTER *Canton, Ill.*

UNEQUAL LOADS OK. Power output differences are common when two or more motors drive one load. No two motors have same characteristics or full-load slip.

Adjust belt tension to equalize loads. Use idler to cut slip, or renew belt lacing, making joint between belt ends smaller. See that pulleys are clean and don't slip. POWER's Data Sheet No. 125 (Jan '43, p 138) offers some data helpful in this problem.

A J BREUGELMANS *Hoboken, N. J.*

RECONDITION BEARINGS or install new ones before rotor of motor *A* binds or seizes in stator and burns out motor.

ARTHUR BELTON *Montreal, Can.*

OTHER READERS who gave helpful hints on the trouble causes are:

LOUIS S GEE	*Abilene, Tex.*
E A ROBERTS	*Carlsbad, N. M.*
JOHN C PORTER	*Rock Hill, S. C.*
P VANHERK	*Liege, Belgium*
KENNETH E NEFF	*New York, N. Y.*
ART CANNON	*Laurence Harbor, N. Y.*

Sorry we couldn't publish these good answers. No space left!

Marmaduke's Mailbox

I wonder how old Marmaduke Surfaceblow is? According to the many places he's worked, he must be at least 150 years old.

In spite of his cantankerous ways, he seems to be a very level-headed person at that. I hope that Sandpaper Gin don't get the best of him, because I really enjoy his tales.

JESSE SMITH *Toledo, Ohio*

•

I enjoy your magazine very much. It brings you right into the plants as if you were there. I hardly skip a word from cover to cover. And you can be sure the hot air Marmaduke Surfaceblow shoots around is absorbed.

In fact, all the engineers at our plant have taken a deep interest in Marmy since I first subscribed. Keep old Surfaceblow.

BILLY H COKER *Lompoc, Calif.*

I see Surfaceblow takes a shot at boiler inspectors in the July issue. Of course, it's the best Surfaceblow yet—and that's saying something!

I think the old boy would have liked boiler inspecting if he had stuck to it a little longer. Speaking from experience, I know he would have found the majority of plant owners more receptive to inspectors' recommendations than old man Jackson was.

AL JETER, *Editor* *Hartford, Conn.*
The Locomotive

•

I get a lot of useful tips from *Power*. It's the best magazine for stationary engineers ever published. And keep up those Marmaduke episodes. That guy is really good. He's my idea of a full-fledged engineer. And that's plenty.

W W PARSONS *Chatham, Ontario*

Since Marmaduke made his bow in *Power*, my maintenance men, pipe fitters and electricians read his stories each month. One Irish pipefitter here exclaims after reading each story, "Well, I'll be darned, that's pretty good." But he doesn't crack a smile.

My boys really talk about these stories for days. And *Power* gets a real good workout since Marmy is sounding off in it. Hope he keeps at it.

NEWELL NELSON *Aurora, Ill.*

•

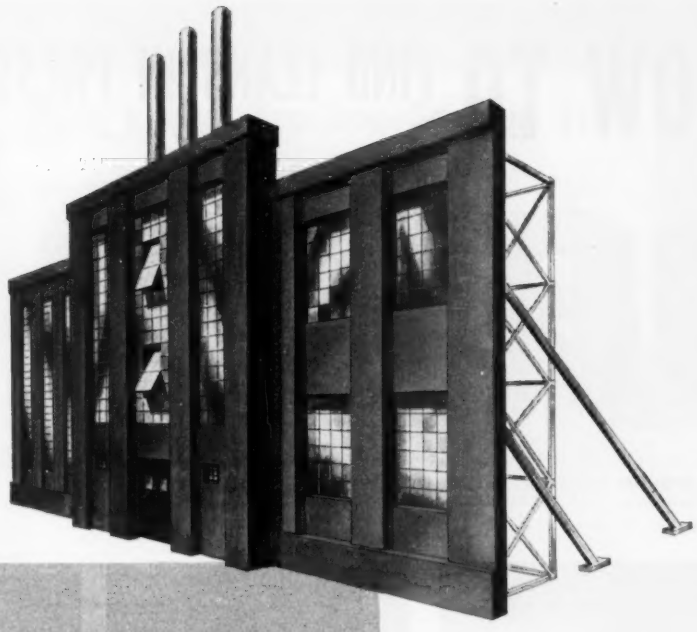
Marmaduke is always the salt of the literary meat in *Power*.

A S NICHOLSON *Detroit, Mich*

•

That story Marmaduke told about "Quiet Quinn Has the Last Laff" in August is one way to cool down a windbag.

G G AVANT *Wilmington, N. C.*



There's more than meets the eye...

This is The BETZ INDICATOR, a monthly publication devoted to general discussion of all water problems. It's free. Write.

. . . especially in a boiler plant!

Insofar as mechanical equipment is concerned, a boiler plant may be complete in every respect. But, completeness of equipment will not necessarily assure the most efficient operation of the system. An adequate and well-controlled program of boiler water treatment, too, is highly important. A water conditioning engineering service should be an integral part of your plant operation.

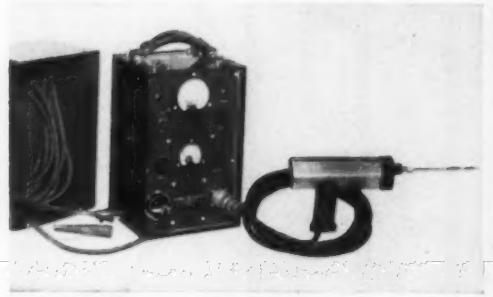
As a nationwide service organization of engineers and chemists specializing in the solution of all water problems, we offer a complete water conditioning service that is scientifically correct . . . complete . . . economical. If the results you are presently obtaining are not entirely satisfactory, let a BETZ engineer explain more fully how our specialized service can help you. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

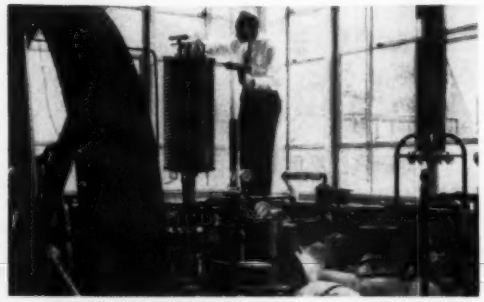
BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

HOW TO FIND LEAKS IN PRESSURE UNITS

By **RAY WILLIAMS**, *Special Products Div, General Electric Co*



LEAK DETECTOR has pistol-grip probe, control unit, wiring and carrying handle. Probe and leads fit in cover when not in use



REFRIGERANT LEAKS are easily tracked down with lightweight probe. Don't take chances; use ladder for above-floor tests

USE HALOGEN TRACER in nitrogen-filled transformer so detector spots any leaks

STORAGE TANKS, like this 1000-gal one for cool milk, are easily tested for leaks

TEST FOR LEAKS around welded seams, pipe taps, tube ends, with probe like this

PORTABLE DETECTOR is used anywhere in plant, as on this water-cooling unit

POWER ENGINEERS MAY HAVE OVERLOOKED General Electric Co's type H leak detector. It detects halogen vapors coming from leaks so small only 1/100 oz passes the opening in one year. (These vapors contain chlorine, bromine, iodine or fluorine; examples—Freon and carbon tetrachloride.) Use the detector to find leaks in refrigeration systems, tanks, instrument tubing, transformer casings, turbine-generators, bellows and other pressure systems.

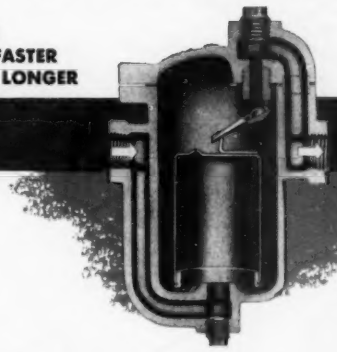
To use, detector is connected to a suitable power supply (115-v 60-cps needed. If unit to be leak-tested doesn't contain halogen compound, a "tracer," often Freon, is put in. Insert 1 oz per 30 ft volume to find a leakage of 1 oz per yr. Fill space with Freon gas to find leaks of 1/100 oz per yr.

Apply rated pressure to unit, keeping room free of halogens. For instance, use 100-psi air pressure in a 100-psi tank.

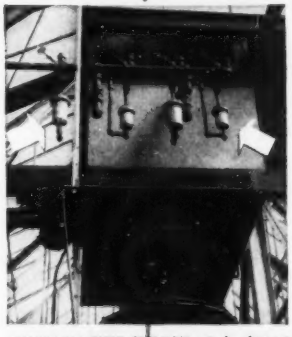
Hold probe nozzle about ½ in. from surface of unit tested. Move probe about ½ in. per sec. Be careful around joints and seams where leaks are likely. Leak is shown on instrument meter or by change in pitch of earphone noise. Detector indicates presence of leak—not its size.

Here's the Trouble-Saving Trap for Low Pressure Vacuum Return Heating

IT GIVES YOU MORE HEAT, FASTER —AND LASTS LONGER



"50% REDUCTION IN STEAM TRAP MAINTENANCE since installing Armstrongs on 5 psi system with vacuum return."—John Deere Ottumwa Works, Ottumwa, Iowa,



"HEAT-UP TIME CUT 10%. Only $15.00 annual maintenance on 300 traps on low pressure vacuum return heating system." —John Deere Harvester Works, East Moline, Illinois.

ARMSTRONG inverted bucket steam traps are real *trouble-savers* on low pressure heating systems for these quickly understandable reasons:

1. No Trouble Holding Vacuum — you can't hold return line vacuum with leaky steam traps. Armstrong's *stay* steam-tight — often go for years without repairs. You get a big bonus in steam and fuel savings, too.

2. No Trouble with Corrosion — air and CO_2, particularly in unit heater coils, cause serious corrosion. Every time an Armstrong trap opens there is a momentary pressure drop that "pumps" air down to the trap where it is discharged along with condensate.

3. No Trouble Getting Fast Heat-up — Armstrong traps quickly draw off air that retards heat-up. Where large amounts of air are encountered when steam is turned on, traps with big thermically-operated bucket vents are available with capacity to handle 500 to 1500 cu. ft. of free air per hour.

4. No Trouble Keeping Heating Units HOT — Armstrong traps discharge condensate *at steam temperature* as fast as it accumulates. This keeps heaters packed with hot, dry steam for top BTU output.

5. No Trouble with the Traps — There is nothing to stick, clog, leak or collapse in an Armstrong trap. The hardened chrome steel valves and seats in traps for heating service are identical in design, workmanship and materials to those in Armstrong traps for service at 1500 psig, 900°F. Interior trim is corrosion-resistant 18-8 stainless. No wonder they last so long with so little attention!

Armstrong traps are guaranteed to give you satisfaction or your money will be refunded. They are guaranteed against defects *forever.* Call your local Armstrong Representative for the traps you need now. ARMSTRONG MACHINE WORKS, 812 Maple Street, Three Rivers, Michigan.

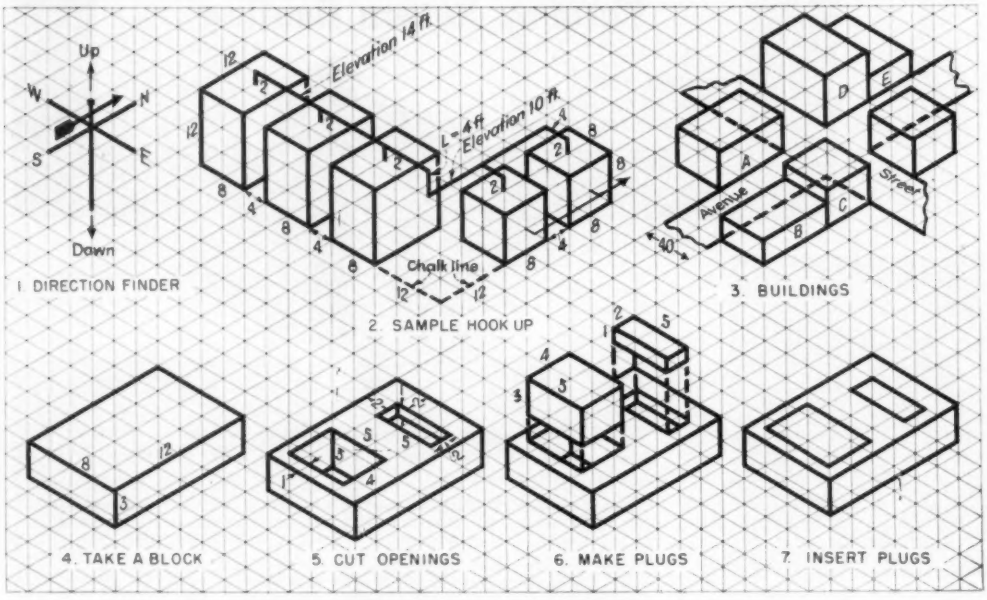
SEE OUR CATALOG IN SWEET'S

SEND FOR THE 36-PAGE STEAM TRAP BOOK FOR COMPLETE DATA

ARMSTRONG STEAM TRAPS

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



Isometric Sketching-3

► HERE ARE some more ways to use the isometric sketching paper:

First as usual, sketch in your weather vane or direction finder, Fig. 1.

Each division on the ruled paper can be any unit distance that happens to be convenient for the particular job.

Isometrics are wonderfully handy for picturing equipment hookups, Fig. 2. In such sketches, the boilers and various process units may be drawn in their true form, but often it is enough (and a lot less work) to picture these units as simple square-cornered blocks.

Hookup Sketch. In Fig. 2, each space on the ruled paper is taken as 4 ft. It is then clear that the large equipment units are 8 ft wide, 12 ft deep and 12 ft high. The smaller units are 8 ft on all sides.

To keep out of trouble when you are making a hookup sketch, be sure to note exactly where the floor is, and the actual elevation of all points.

In this example, the first step is to draw on the floor an imaginary chalk line along the fronts of the units. Starting from this line it is easy to sketch in the units as shown.

Next, spot the center of the top of each unit (note how). From this point run a riser 2 ft straight up. Next you draw the left-hand header and note that its elevation is 14 ft above the floor. Note also that the right-hand header is 10 ft above the floor.

The only real trick is to know where to draw the vertical link "L" connecting the upper header with the lower header. Here's how to place it right: You know for sure that this connection must be 4 ft long and vertical. The position selected is the only possible one that meets these requirements. Test it for yourself.

Starting point of Fig. 3 is a north-south avenue 40 ft wide, intersecting an east-west street 40 ft wide. The buildings at this corner are shown as simple blocks. Note that building *A* faces the avenue for 60 ft, is 40 ft deep and 30 ft high. Just for practice, scale off the corresponding dimensions of building *B, C, D* and *E*.

Working Sketch. Fig. 4, 5, 6 and 7 will show you how to turn written instructions into sketches any carpenter or mechanic can follow. Here are the words. Check them against the sketches step by step:

Fig. 4: Make a square-cornered block 12x8x3 in. Lay it level with small end pointing north.

Fig. 5: Mortise a square-cornered hole entirely through the block. Make it 5 in. east-west, and 4 in. north-south. Keep it 1 in. from the west and south edges of the block.

Mortise another hole 1 in. deep, 5 in. east-west, and 2 in. north-south. Keep it 2 in. from the north and west sides of the block.

Fig. 6: Cut plugs to fit these holes exactly.

Fig. 7: Insert the plugs in the holes.

ANACONDA Arsenical Admiralty—

a practical solution to tube dezincification

What causes dezincification?

Metallurgical research indicates a number of conditions causing dezincification of condenser and heat exchanger tubes:

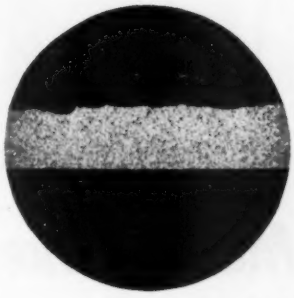
LAYER TYPE dezincification tends to be the result of a critical degree of acidity of the cooling water.

PLUG TYPE dezincification is more apt to occur where the cooling water is neutral or alkaline.

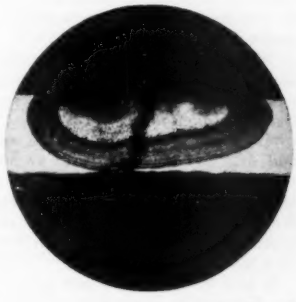
LOW WATER VELOCITY may accelerate the loss of zinc by failing to wash away copper salt solutions, thereby permitting redeposition of copper.

HIGH COOLING WATER TEMPERATURES hasten over-all corrosion reactions and seem to favor the electrochemical process causing redeposition of copper.

LOW OXYGEN CONTENT of cooling water is also considered a factor in accelerating the redeposition of copper.



Longitudinal section through Arsenical Admiralty tube. No evidence of dezincification. Upper surface is waterside. 7x.



Longitudinal section through wall of non-Arsenical Admiralty tube showing dezincification plug starting from waterside (upper surface). 7x.

Arsenic as an Inhibitor

Laboratory studies and field installations have clearly indicated the effectiveness of small quantities of arsenic in Admiralty and other copper alloys as an inhibitor to dezincification. The inhibiting action of arsenic, as well as of other inhibitors, is not well understood. One theory holds that the inhibitor covers anodic areas to prevent initial selective corrosion; another states that it forms a film of an electropotential equal to that of the copper to prevent the copper redepositing.

For Technical Counsel

The files of Anaconda's Technical Department and the experience of its engineers cover the case histories of condenser and heat exchanger tubes operating under the widest variety of conditions. These are freely available to you to help you select the right alloy for your installation. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

for efficient heat transfer **ANACONDA®** **HEAT EXCHANGER TUBES**

"Bilgewater on Don Swift's story in June *Power*," roared Marmaduke Surfaceblow

Marmaduke Unfouls a Plant

► THAT LUBE-OIL contamination story by Don Swift on page 97 in June POWER was a lulu. He told how the porous cast iron near a turbine bearing leaked oil into the exhaust end and contaminated the condensate. But it took a lot of masterminding by Don to find the source of trouble.

"I'll bet even old Marmaduke Surfaceblow can't top that for oil contamination," I yelled over to our Ben Skrotzki, who edited the article.

"Let's look up the old buzzard and find out," came back Ben. So we hotfooted it down the street to O'Houlihan's Machine Shop & Engineering Works. We climbed the rickety wooden stairs to the second floor and stopped in front of a glazed windowed door.

In bold red letters the sign said:

Marmaduke Surfaceblow, Esq
Consulting Engineer

We barged into the office and found the old cantankerous goat bent over his roll-top desk. He had steam-engine indicator cards scattered all over and was studying one through a magnifying glass.

"Here's an oil-contamination story that really took some brain work to solve," I blurted, laying the story before him.

Marmy snorted a blast that rattled the windows, and roared. "BILGEWATER ON THAT STORY. *I tracked down one oil-fouled plant that had top-notch West Coast engineers buffaloed.*"

Ben and I relaxed and held on to our hats. Marmaduke propped his size 16 shoes up on the window sill and blasted away.

"Back in 1923 I had the chief maintenance mechanic's job at a Hunters Point shipyard in San Francisco Bay," roared Marmaduke. "One day a large French liner pulled in. She was an old passenger ship and in really sad shape. All her six watertube boilers were contaminated with fuel oil. Two boilers had most of the tubes burned out and the other four boilers had plenty of tubes to renew.

"For two weeks, while my gang renewed tubes and did other repairs, the shipyard's ace trouble-shooter and the ship's chief engineer snooped around trying to find out how that bunker-C fuel oil got in the boilers. But no soap.

"I got tired of watching them bark up wrong alleys, so I told my boss I'd find the trouble and it wouldn't take me two weeks.

"'You're off your course, Surfaceblow,' barked the super. 'We checked every place that fuel oil could possibly leak into the condensate system. If you ask me, it looks like foul play.'

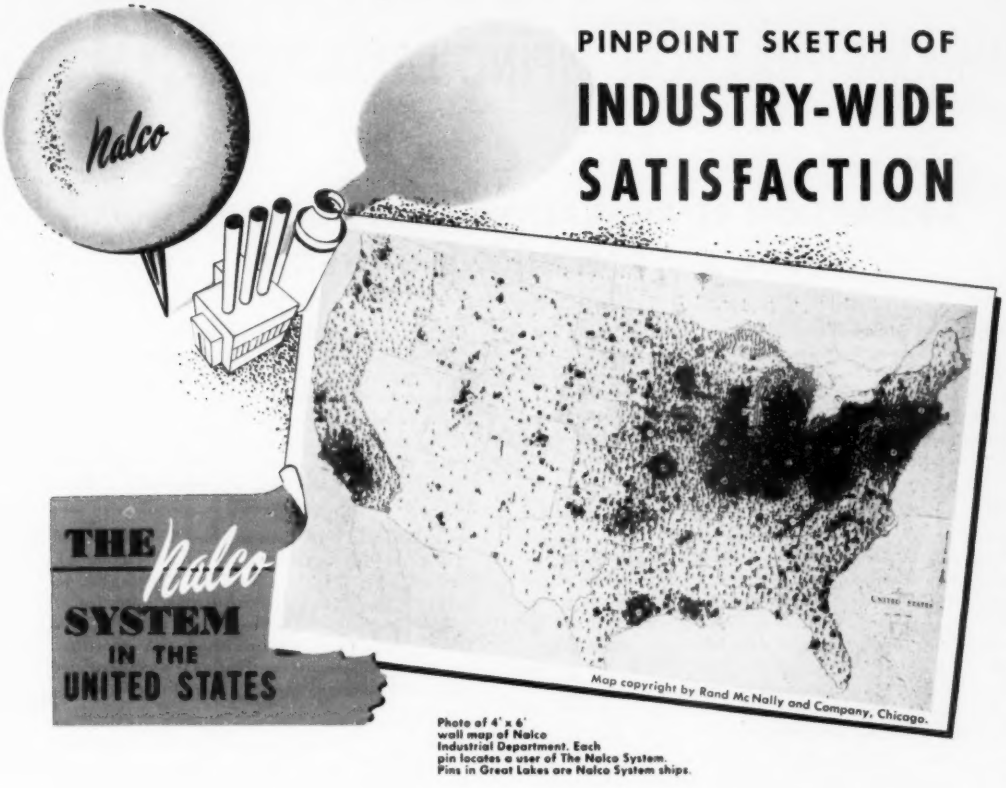
"'Bilgewater on the sabotage angle,' I told him. 'That's too juvenile to even talk about. I'll make you a bet. If I can't find the trouble before the day's over, you can keep my next month's salary. But if I straighten this thing out for you, how about a week off with pay.'

"'OK,' he agreed, 'It's a deal.'

"'All I ask,' I continued tactfully, 'is that your pencil-pushing engineers keep the hell out of the engine room while a real engineer does his stuff.' He agreed.

"I spent two hours checking every place for an oil leak I could think of. Aboard ship, the double-bottom tanks have a mass of heating coils from bow to stern. With bunker-C oil in the ship's bottoms, cooled by sea water directly

(*Continued on page* 208)



PINPOINT SKETCH OF INDUSTRY-WIDE SATISFACTION

Photo of 4' x 6' wall map of Nalco Industrial Department. Each pin locates a user of The Nalco System. Pins in Great Lakes are Nalco System ships.

NALCO System installations and ships*—each a pin in the map above—literally blanket the industrial and fresh water navigation areas of our country. The reason is simple: *satisfaction with Nalco chemicals and services.*

If you are not already getting the efficiency and economy of The Nalco System in your plant, now is the time to find out about it. Best Nalco Salesmen are Nalco Users—and there are sure to be several near you. For prompt Nalco Service, call or write today.

**This map does not show the thousands of miles of railroad lines and terminals served by Nalco . . . That requires another large map by itself!*

NALCO CHEMICALS AND SERVICES

- **WATER TREATMENT**—Chemicals and Consulting Services. Boiler feedwater, internal and external, locomotive and stationary. Cooling waters. Paper and pulp mill processing waters. Chemical and Food processing waters. Potable waters (slimicides and softening).
- **COMBUSTION CATALYSTS**—SR Series Chemicals for coal and oil fuels.
- **ANTIFOAM AND STABILIZATION** chemicals for water and other liquids in process.
- **LABORATORY RESEARCH**, commercial analyses, consulting services.
- **PAPER AND PULP MILL** pitch and clay control, size control, slime and mold prevention.

Additional information on any Nalco Chemicals and Services will be furnished without obligation.

NATIONAL ALUMINATE CORPORATION
6222 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco SYSTEM...Serving Industry through Practical Applied Science

JENKINS PRACTICAL PIPING LAYOUTS 59

How to plan

ABSORPTION REFRIGERATION PIPING CONNECTIONS FOR AIR CONDITIONING SYSTEM

While the principles of absorption refrigeration have been well-known for a hundred years, the practical application of this system to comfort air conditioning is relatively new. Installations of absorption refrigeration systems for air conditioning plants are both practical and economical, in sizes from 100 tons up, wherever steam is available during the summer months.

Absorption systems for air conditioning, such as the one illustrated, generally use water as the refrigerant and a water absorbent salt solution, for example, lithium bromide. The absorbent solution in the absorber dissolves the water vapor from the chilled water in the evaporator (above the absorber but within the same shell). This maintains a very low pressure in the evaporator and, consequently, a very low water temperature. The small amount of chilled water that flashes in the evaporator cools the remaining water to the required temperature. The chilled water is then pumped through the coils of the air handling units.

The salt solution in the absorber dissolves the *flashed* water vapor from the chilled water, diluting the salt solution to a weak one. The heat picked up by the solution in the absorber is removed by the condensing water. The weak solution is withdrawn from the absorber; a portion is pumped to an eductor, and the remainder to the solution regenerated through an annular tube heat exchanger. In this heat exchanger, the weak solution is preheated by the warm, strong solution coming from the regenerator. In the regenerator, the weak solution is heated by a steam coil to boil off the water vapor dissolved in the absorber. This strengthened solution then returns to the absorber through the heat exchanger and eductor.

The steam boiled off the weak solution in the regenerator is condensed in the condenser section of the regenerator, and returned to the evaporator pan through the vapor seal loop. Low pressure is maintained in both shells by means of tandem steam and water jets. The cold water used in the water jet is used for makeup in the cooling tower where the condensing water is cooled for reuse in the absorber and condenser.

Jenkins Fig. 270 Bronze Gate Valves are recommended for steam line and steam condensate shut-off service in this hookup. This valve, together with 35 other Jenkins Bronze gates for all types of service, is described in the folder offered below, Form 181-A. *Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.*

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run*. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal. Sold through leading Industrial Distributors everywhere.

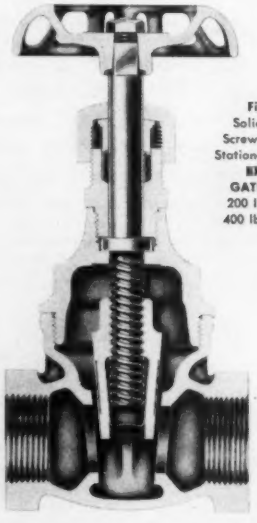


Fig. 270
Solid Wedge
Screw-in Bonnet
Stationary Spindle
BRONZE
GATE VALVE
200 lbs. Steam
400 lbs. O.W.G.

SEND FOR THIS FOLDER
It illustrates and describes the complete line of Jenkins Gate Valves, which includes 30 different patterns for various service conditions. Fill out and mail the coupon today.

JENKINS BROS., 100 Park Avenue, New York 17, N. Y.

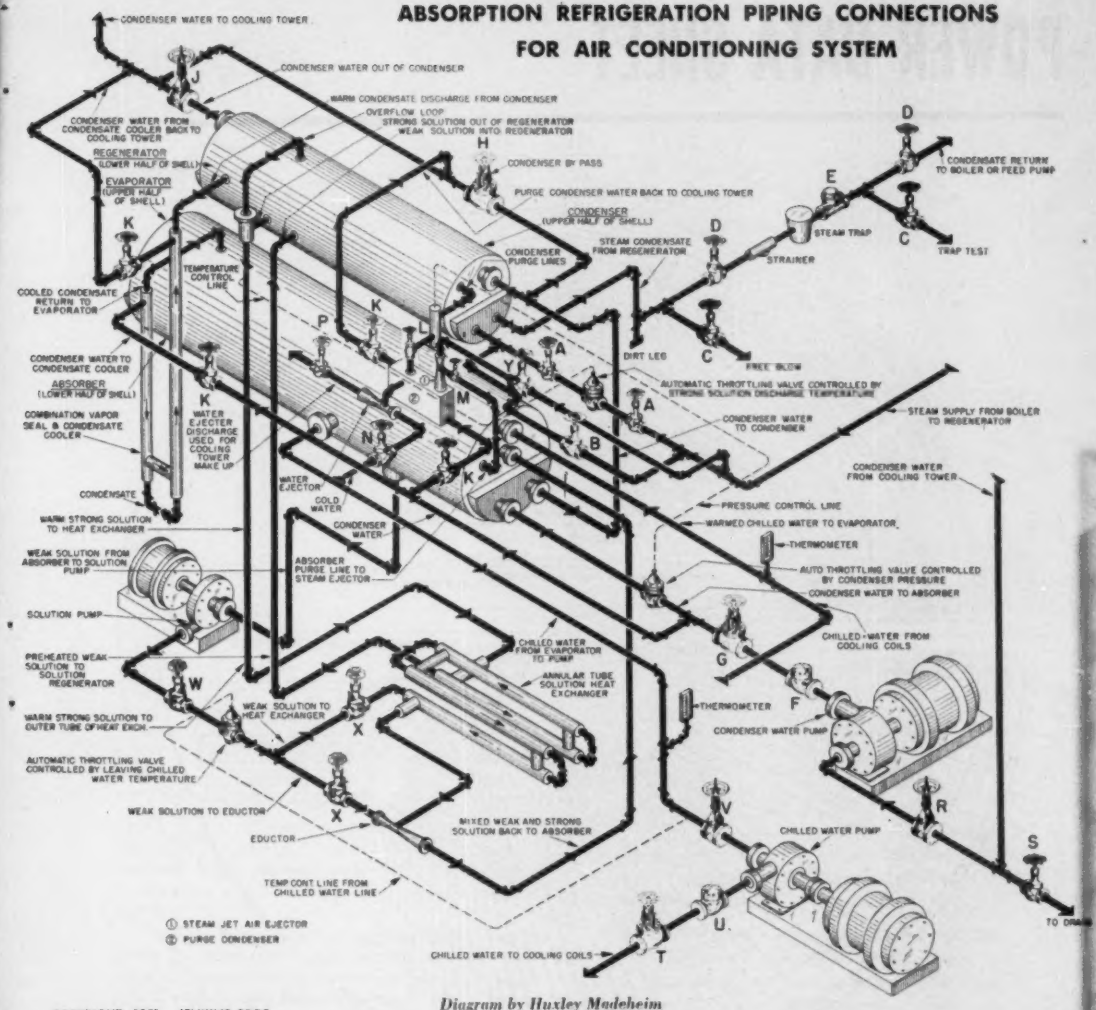
Please send folder on Bronze Gate Valves

Name _____

Company _____

Address _____

ABSORPTION REFRIGERATION PIPING CONNECTIONS FOR AIR CONDITIONING SYSTEM


CONDENSER WATER TO COOLING TOWER
CONDENSER WATER OUT OF CONDENSER
WARM CONDENSATE DISCHARGE FROM CONDENSER
OVERFLOW LOOP
STRONG SOLUTION OUT OF REGENERATOR
WEAK SOLUTION INTO REGENERATOR
CONDENSER WATER FROM CONDENSATE COOLER BACK TO COOLING TOWER
REGENERATOR (LOWER HALF OF SHELL)
EVAPORATOR (UPPER HALF OF SHELL)
CONDENSER BY PASS
PURGE CONDENSER WATER BACK TO COOLING TOWER
CONDENSER (UPPER HALF OF SHELL)
CONDENSATE RETURN TO BOILER OR FEED PUMP
STEAM TRAP
TRAP TEST
STRAINER
STEAM CONDENSATE FROM REGENERATOR
CONDENSER PURGE LINES
TEMPERATURE CONTROL LINE
COOLED CONDENSATE RETURN TO EVAPORATOR
DIRT LEG
FREE BLOW
CONDENSER WATER TO CONDENSATE COOLER
ABSORBER (LOWER HALF OF SHELL)
AUTOMATIC THROTTLING VALVE CONTROLLED BY STRONG SOLUTION DISCHARGE TEMPERATURE
STEAM SUPPLY FROM BOILER TO REGENERATOR
COMBINATION VAPOR SEAL & CONDENSATE COOLER
WATER EJECTER DISCHARGE USED FOR COOLING TOWER MAKE UP
CONDENSER WATER TO CONDENSER
CONDENSER WATER FROM COOLING TOWER
CONDENSATE
WATER EJECTOR
COLD WATER
PRESSURE CONTROL LINE
WARM STRONG SOLUTION TO HEAT EXCHANGER
CONDENSER WATER
WARMED CHILLED WATER TO EVAPORATOR
THERMOMETER
WEAK SOLUTION FROM ABSORBER TO SOLUTION PUMP
ABSORBER PURGE LINE TO STEAM EJECTOR
AUTO THROTTLING VALVE CONTROLLED BY CONDENSER PRESSURE
CONDENSER WATER TO ABSORBER
SOLUTION PUMP
CHILLED WATER FROM COOLING COILS
CHILLED WATER FROM EVAPORATOR TO PUMP
PREHEATED WEAK SOLUTION TO SOLUTION REGENERATOR
ANNULAR TUBE SOLUTION HEAT EXCHANGER
THERMOMETER
WEAK SOLUTION TO HEAT EXCHANGER
WARM STRONG SOLUTION TO OUTER TUBE OF HEAT EXCH.
CONDENSER WATER PUMP
AUTOMATIC THROTTLING VALVE CONTROLLED BY LEAVING CHILLED WATER TEMPERATURE
WEAK SOLUTION TO EDUCTOR
MIXED WEAK AND STRONG SOLUTION BACK TO ABSORBER
CHILLED WATER PUMP
EDUCTOR
TEMP CONT LINE FROM CHILLED WATER LINE
TO DRAIN
① STEAM JET AIR EJECTOR
② PURGE CONDENSER
CHILLED WATER TO COOLING COILS

COPYRIGHT, 1951 — JENKINS BROS.

Diagram by Huxley Madeheim
Consulting Engineer

Code	Quan.	Jenkins Valve	Service
A	2	Fig. 270 Bronze Gate	Steam Line Shutoff
B	1	Fig. 956 Bronze Globe	Steam Valve Manual By-Pass
C	2	Fig. 106-A Bronze Globe	Trap Test, Free Blow
D	2	Fig. 270 Bronze Gate	Steam Condensate Shutoff
E	1	Fig. 762 Br. Swing Check	Prevent Condensate Backflow
F	1	Fig. 624 I.B.B.M. Sw. Check	Condenser Pump Discharge
G	1	Fig. 142 I.B.B.M. Globe	Condenser Pump Discharge
H	1	Fig. 142 I.B.B.M. Globe	Condenser By-Pass
J	1	Fig. 651 I.B.B.M. Gate	Condenser Discharge Shutoff
K	4	Fig. 106-A Bronze Globe	Condenser Water
L	1	Fig. 744-G Bronze Needle	Condenser Purge Line

Code	Quan.	Jenkins Valve	Service
M	1	Fig. 743-G Bronze Needle	Absorber Purge Line
N	1	Fig. 106-A Bronze Globe	City Water to Water Ejector
P	1	Fig. 47-U Bronze Gate	Water Ejector Discharge
R	1	Fig. 651 I.B.B.M. Gate	Condenser Pump Suction
S	1	Fig. 106-A Bronze Globe	Condenser Water Drain Valve
T	1	Fig. 142 I.B.B.M. Globe	Chilled Water Pump Discharge
U	1	Fig. 624 I.B.B.M. Sw. Check	Chilled Water Pump Discharge
V	1	Fig. 651 I.B.B.M. Gate	Chilled Water Pump Suction
W	1	Fig. 75-A All Iron Globe	Solution Flow Control
X	2	Fig. 75-A All Iron Globe	Solution Flow Control
Y	1	Fig. 956 Bronze Globe	Steam Ejector Shutoff

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A **Use the right type valve for the service**

B **Place valves correctly in the line**

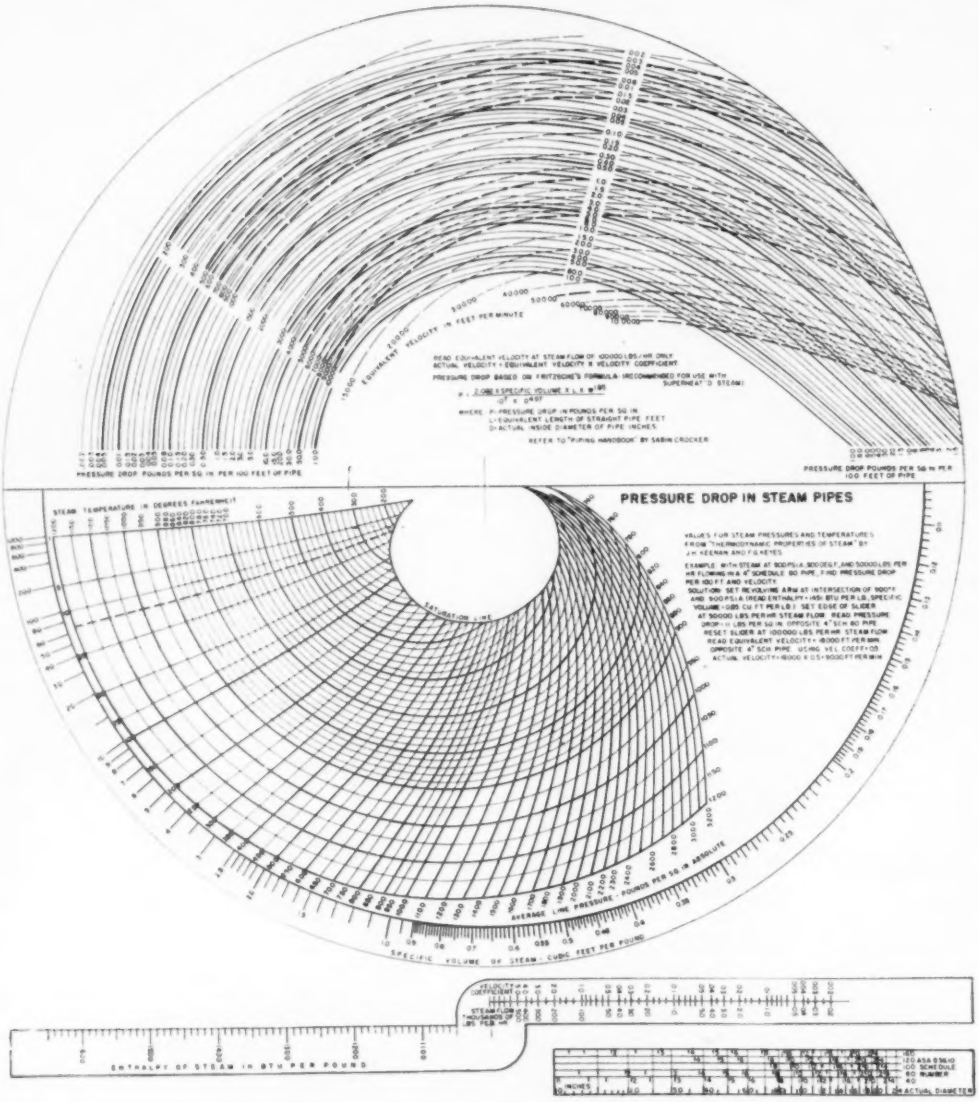
C **Choose Jenkins for lifetime economy**

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK

Jenkins Bros

POWER DATA SHEET

NUMBER 234


PRESSURE DROP IN STEAM PIPES
PRESSURE DROP POUNDS PER SQ IN PER 100 FEET OF PIPE
EQUIVALENT VELOCITY IN FEET PER MINUTE
STEAM TEMPERATURE IN DEGREES FAHRENHEIT
AVERAGE LINE PRESSURE, POUNDS PER SQ IN ABSOLUTE
SPECIFIC VOLUME OF STEAM, CUBIC FEET PER POUND
ENTHALPY OF STEAM IN BTU PER POUND
VELOCITY COEFFICIENT
STEAM FLOW IN THOUSANDS OF LBS PER HR
ACTUAL INSIDE DIAMETER

Pressure Drop In Steam Pipes

▶ **HERE'S A HANDY CHART** for making quick estimates of steam-pressure drops in standard piping. To use, trace rotating arm and sliding scale on separate sheets of stiff paper. Pivot rotating arm at the cross lines on center of main chart. Sliding scale is moved along right-hand arm of rotating arm. Then you're all set to follow directions on chart to calculate pressure drops.

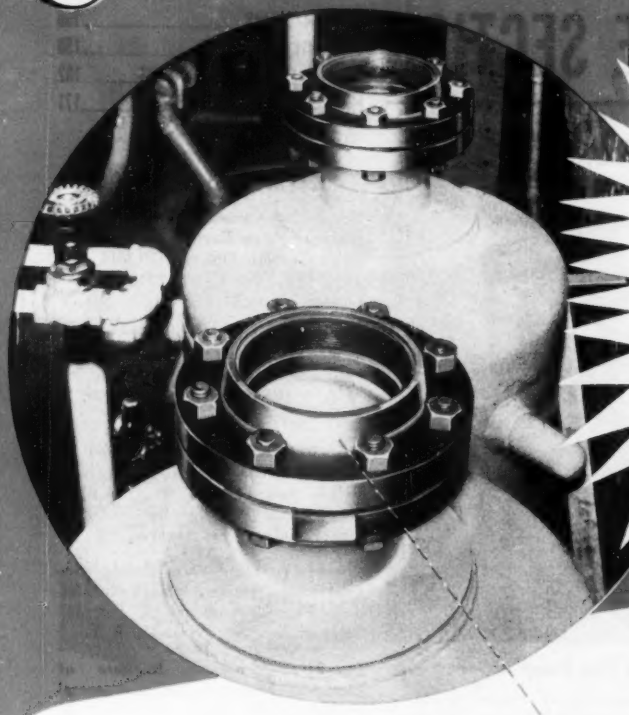
Executives and design engineers may obtain this chart in full size, 10 inches in diameter, for easier reading.

Address The Kuljian Corporation, 1200 N Broad St, Philadelphia 21, Pa. on your letter head and ask for a complimentary copy.

W J Fadden Jr, The Kuljian Corp

Copyright 1951 by W J Fadden, Jr.

Like a Fuse for Electric Power Load . . .



SAFETY HEADS *for* PRESSURE LOAD

It would be hard to conceive of an electric power application without fuses to afford relief in case of overload. When the fuse element ruptures it breaks the circuit—to save the line and equipment and prevent fire.

When the load is pressure of gas or liquids—BS&B Safety Heads give that same instant, full, pipe-sized relief in the same simple, positive manner by the rupture of a disc. Super-accurate pressure "fuses," Safety Heads will rupture within ± 5% of the pre-determined pressure. Discs are available within a range of 5 lbs. to 40,000 lbs. The resulting opening is unrestricted—as complete as the break in a fuse. No other pressure relief device acts as fast to prevent damage to equipment, property or personnel.

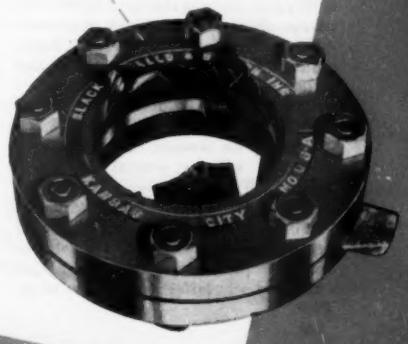
Safety Head action is positive because there are no moving parts to break or to wear out, become fouled or fused at critical moments or prove inadequate to relieve a sudden excessive pressure surge.

Whether your pressure applications are for air, gas or liquids—bland or corrosive—BS&B is equipped to provide Safety Heads for them, with pre-tested discs of the proper metal element, designed to rupture at the pre-determined pressure and temperature specified for safety. Used as primary relief devices or to protect or supplement relief valves, BS&B Safety Heads are accurate, code-accepted for your pressure lines or vessels.

Write today *for free catalog and complete details. There is no charge for a complete analysis of your pressure problem by the BS&B laboratory and engineering staff.*

BLACK, SIVALLS & BRYSON, INC.

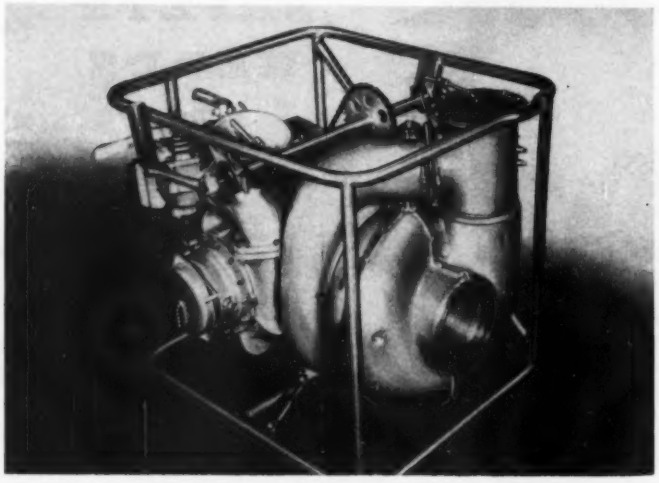
Dept. 36-Q, 7500 East 12th St.
Kansas City 3, Missouri



SAFETY BS&B HEADS

READER SERVICE SECTION

POWER NEWS 156
TECHNICAL BRIEFS 158
PLANT EQUIPMENT NEWS 162
NEW FREE BULLETINS 171



Portable Gas Turbine Drives Fire Pump

Newly developed, portable, manual-starting, 45-hp gas turbine requires no cooling system. Unit, known as the T-45, is lightweight, about 165 lb with fire pump, gears, accessories, but without fuel tank. It measures close to 2 ft in each dimension, has speed of 40,000 rpm and provides pump output of 500 gpm at 100 psi

COMING EVENTS

Nov 26-29—Canada's Power Show, Institute of Power Engineers, Royal York Hotel, Toronto, Ont. W G Child, genl secy, IPE, 496 Church St, Toronto, Canada.

Nov 26-30—American Society of Mechanical Engineers, annual meeting, Chalfonte Haddon Hall, Atlantic City, N. J. O B Schier, secy, ASME, 29 W 39th St, New York 18, N. Y.

Nov 26-Dec 1—23rd Exposition of Chemical Industries, Grand Central Palace, New York, N. Y. C F Roth, mgr, International Exposition Co, Grand Central Palace, New York 17.

Jan 14-17—Third Plant Maintenance Conference, Convention Hall, Philadelphia, Pa. Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

Jan 21-25—American Institute of Electrical Engineers, winter general meeting, Hotel Statler, N. Y. H H Henline, secy, AIEE, 33 W 39th St, New York 18, N. Y.

Maintenance Show Features Special-Industry Sessions

► THIRD ANNUAL PLANT MAINTENANCE CONFERENCE, scheduled for Convention Hall, Philadelphia, Pa., January 14-17, 1952, bids fair to be most intensive meeting ever held on maintenance problems.

Last year *Operating Engineer* gave this show a full treatment (March 1951, pp 19-29) because program dealt so strongly with practical problems of the plant man. At that time 10,000 men from all over the country registered. There were 45 speakers from 28 industries and 23 states. Exhibitors totaled 175.

This year over 100 speakers will handle 34 separate get-togethers. Seven of these, six sessions and the annual banquet, will be general in nature. They will cover subjects of common interest. These include introduction and maintenance costs for opening day, and sessions on inspection methods and records for preventive maintenance, planning and scheduling maintenance work, training maintenance workers and supervisors, and finally lubrication.

The 27 sectional meetings break up as follows: five on the first day, six on the second, and 16 on the last. First five take up project preparation, maintenance in plant buildings, in chemical plants, in metal-working plants, and for electrical equipment.

Second day's sessions concentrate on problems peculiar to size of plant and special maintenance problems of each size division. Four of the six sessions are on small plants in groupings of 1-10 maintenance employes, 11-50, 51-100 and 100-300. Fifth session considers medium-sized plants of 301-800 maintenance employes, while the last takes up large plants with more than 800.

One of most promising events will be the last day's program when 16 round-table groups will tackle day-to-day problems like organization of personnel, maintenance operating policies, safety and plant protection, plant housekeeping, welding, maintenance of mechanical equipment, maintenance of power plants and service equipment, maintenance applications of handling equipment and its upkeep. Other special sessions are on maintenance in aircraft plants, food plants, glass plants, oil refineries, print shops, pulp and paper mills, textile and woodworking plants.

Over 200 companies will display

(*Continued on page 224*)

ENGINEER'S BOOKSHELF...

Turn to page 214 for reviews on recent books in the power field. Feature titles this month:

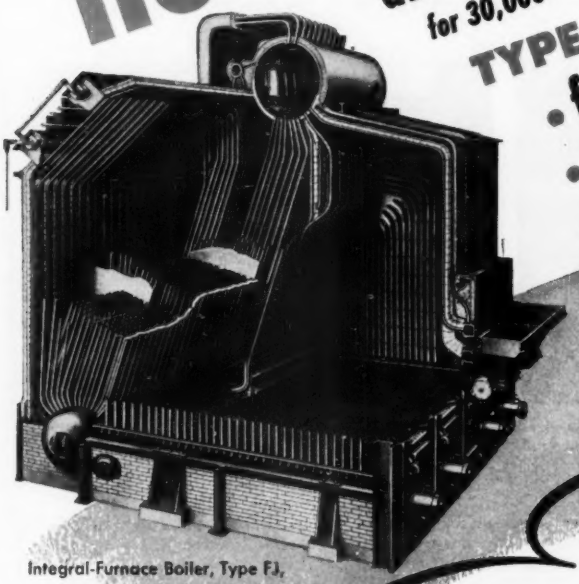
- *Fuel Oil Manual*
- *Transients in Power Systems*
- *Advanced Fluid Dynamics and Fluid Machinery*

now

an integral-furnace boiler for 30,000—70,000 lb. steam per hr.

TYPE FJ SAVES:

- fuel
- maintenance
- space



Another Example of B&W Engineering for Economy

Integral-Furnace Boiler, Type FJ, arranged for stoker firing.

The Integral-Furnace Boiler, Type FJ is a recent addition to B&W's line of completely coordinated furnace-boiler steam-generators. It makes available a compact, highly efficient installation to answer all process, heating, or power requirements from 30,000 to 70,000 lb. per hr.

Complete fuel-flexibility — coal, oil, or gas, with a choice of alternative firing arrangements — protects the investor against radical changes in fuel prices or conditions of supply. This unit burns a wide variety of fuels — including those of inferior grades and low-temperature ash-fusion characteristics — with high heat-rate efficiency, low maintenance, and minimum stack emission.

Unusually wide leeway in water-level and allowable boiler-water concentration is provided by the large drum and efficient cyclone steam separation system . . . which also contribute to ease in meeting sudden and severe load swings.

This unit incorporates all the advantages of Integral-Furnace design, which has proved so successful since its introduction by B&W in 1933. The popular Integral-Furnace "Family" now includes Types FH, FL, FJ, FF, and Shop-Assembled FM Units — spanning a range of steam-capacity now available from 2,800 to 350,000 lb. per hr.

Complete details of construction and operating advantages of the Integral-Furnace Boiler, Type FJ are included in new Bulletin G-70, available upon request from the Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

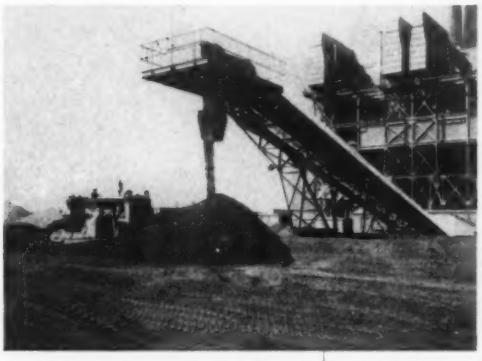
BABCOCK & WILCOX

G-542

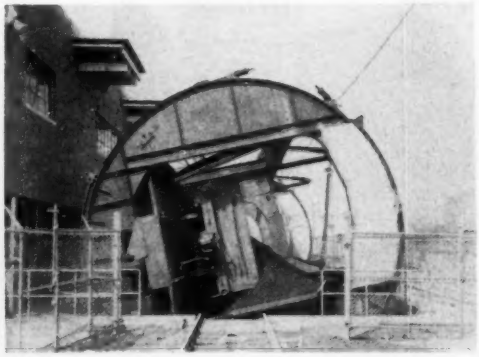
TECHNICAL BRIEFS

Latest engineering developments for busy power men

12 digests for you on:
FUELS AND FIRING
ELECTRICITY
HEATING AND VENTILATING
LUBRICATION



1 Bulldozers frequently serve on large coal-storage piles taking incoming coal, then spreading and compacting it



2 Rotary railroad-car dumpers unload carloads, and then return the car to normal position in about 1½ minutes

Fuels and Firing

Engineering Service in the Coal Industry. *By M A Tuttle, Indianapolis, Ind.*

Discussion of how coal producer can fit available fuel to power-plant equipment.

Customer acceptance of fuel is responsibility of the fuel engineer. He should have not only final say on coal preparation and determination of base sizes but also right to specify size and quality shipped on test or initial orders and when market conditions require substitution. In arriving at coal specifications, coal-handling system at destination becomes first consideration.

Next, segregation of sizes merits more than passing mention. This ever-present and ever-increasing failure to standardize on coal sizes can be placed directly upon the coal industry. If the industry would just reach a firm agreement on sizing, then the trouble would rest solely in the laps of the design and equipment group, who would soon correct their layouts. However, there is always one coal company that is willing to come forward with a size so closely screened that segregation ceases to be a factor.

Non-segregating chutes are no cure for a segregated bunker. The segregation occurs from dumping too much coal at one point. This is easy to cure by scattering stream of coal but most plants prefer to buy non-segregated coal rather than insist upon a non-segregating coal-handling system. *ASME paper. No. 51-FU-4.*

Coal-Handling Conveyors at Powerhouse and Dock. *By F W Lovett, Link-Belt Co.*

Last year U. S. mines produced 556,392,000 tons of solid fuels, bituminous, anthracite and lignite. A tremendous tonnage of rock and refuse also had to be brought to surface and handled to obtain clean, sized coal, ready for shipment. Mechanical conveyors and conveyor-equipped mining machines made this possible.

Suitable coal-handling systems for today's central stations cost between $3 and $5 per kw of installed capacity. This depends upon capacity, type, and scope of operation. Basically, all installations, regardless of size, require equipment for some or all of these functions. Figs. 1, 2.

(1) Unloading coal from trucks, railroad cars, barges and self-unloading boats (2) Feeding coal to system uniformly (3) Conveying and elevating from operation to operation and eventually to storage bunkers (4) Crushing (5) Weighing (6) Sampling (7) Distributing coal in bunkers (8) Storage—daily and reserve (9) Reclaiming from storage—both daily and reserve (10) Dust control. *ASME paper No. 51-F-23.*

Electronic Combustion Control. *By C H Smoot, Republic Flow Meters Co.*

Reduction of panel area, increase of speed, stability and sensitivity, as well as greater operator convenience and easier maintenance, are said to result from electronic combustion control. Electrical and electronic devices in this paper do not represent an entirely new system, but merely the replacement of parts of existing systems with newer components to accomplish the advantages just mentioned.

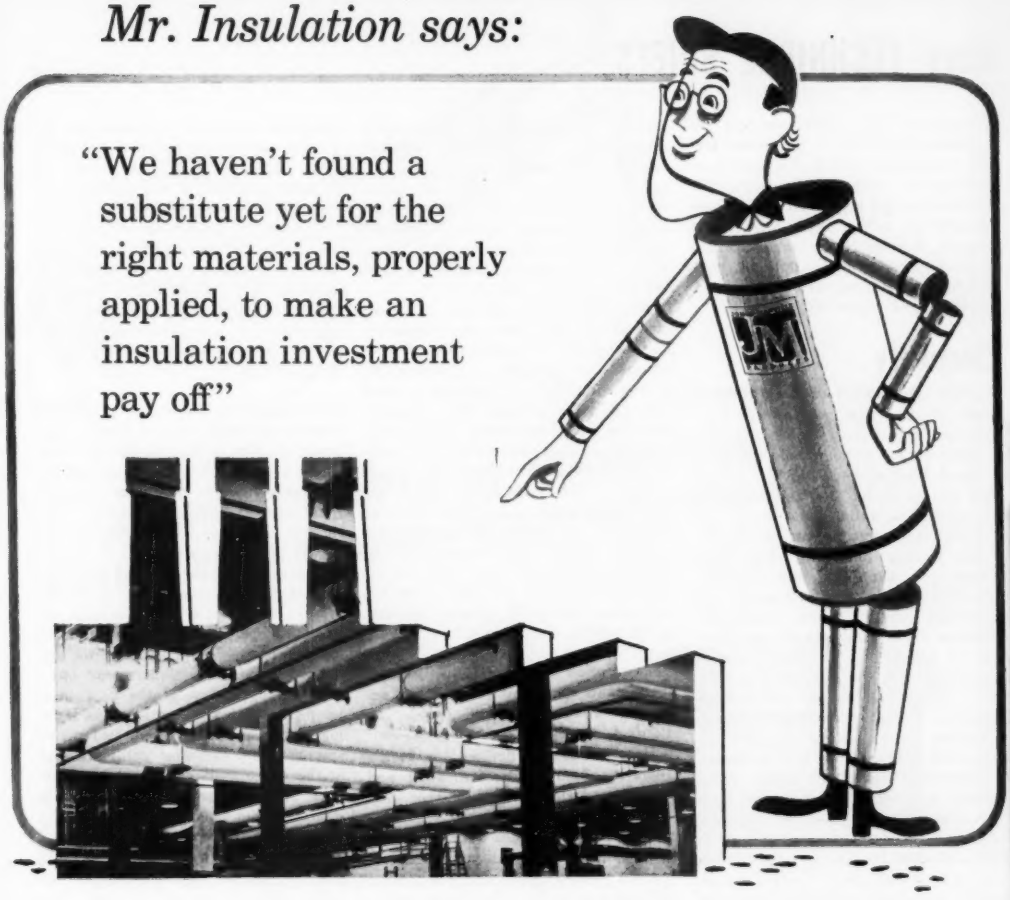
In fact, the basic operating principle of this equipment is far from new and is familiar in other fields as a self-balancing wheatstone bridge. In simplest terms, the mechanism can be considered as a motion transmitting one where a mechanical motion determines the resistance ratios of two arms of a bridge, while the motion is rebalancing the mechanism to produce a desired mechanical output.

With this electronic form of combustion control, the input information may be separated by whatever distance is needed from the output or recording area without any sacrifice in control performance.

The author then outlines an electronic

Mr. Insulation says:

"We haven't found a substitute yet for the right materials, properly applied, to make an insulation investment pay off"



To be successful an insulation job must be properly engineered. In addition, it must have these two important ingredients:

1... THE RIGHT MATERIALS: service conditions vary greatly in industrial applications. That's why no one insulation can serve as a jack-of-all-trades on all jobs. For this reason, Johns-Manville uses asbestos and many other selected raw materials to produce the most complete line of insulations available. These insulations serve applications ranging between the extreme temperatures of 400F below zero to 3000F above.

2... THE RIGHT APPLICATION: Here again Johns-Manville's long experience in the field of insulation can be of value to you. Insulation engineering advice plus the services of insulation contractors trained in Johns-Manville methods of correct application are at your call.

If you are planning an insulation job why not put your problem up to insulation headquarters? Write Johns-Manville, Box 290, New York 16, N. Y.

JM PRODUCTS

Johns-Manville *first in* **INSULATIONS**

More TECHNICAL BRIEFS

Begins on page 158

servosystem for coordination and information transmission in central-station combustion control. The system is described in normal applications, and the fact that the input and output connections are widely separated is also stressed. Further along, the advantages of the automatic control are highlighted and some of the features described in detail. *ASME paper No. 51-SA-41.*

Electricity

Multiple Generators and Processing Lines. *By E E Vonada, Reliance Electric and Engineering Co.*

Discusses the trend toward using individual generators to supply adjustable voltage power for motors driving processing-line units.

Author compares layouts of two different tinning lines and enumerates advantages. Each has new multiple-generator system of power supply for individual motor drives. Important electrical economies include simplification of bus structures, less expensive breakers and use of high-speed generators. Other advantages are greater adjusting flexibility for standard gear-reduction units and for changing diameter of rolls over which strip travels.

"Fade-in" system of motor speed control and synchronization has been developed. This is used with adjustable-speed motors in processing lines where character of loading falls between constant torque and constant horsepower. Horsepower-speed data are given for 20-hp dragmotor with fade-in control driving a 4-roll tension bridle in new galvanizing line. *AISE paper. No number.*

Increased Interrupting Capacity in Fuses. *By John C Levens, Bussmann Mfg Co.*

Throughout the past 15 years fusetron dual-element fuses have been used extensively for protection of power circuits in steel mills. Their increased time-lag eliminates needless blows from harmless over-loads produced by motor starting, capacitor switching, and the like. At first no data on interrupting capacity of dual-element fuses were available. When used on large capacity circuits where high short-circuit currents were possible, the users had to either use the dual-element fuse as sole protection or back up the fuses with expensive circuit breakers having adequate interrupting capacity.

Neither alternative was entirely satisfactory. The first placed unreasonable responsibility on operating electrical engineer. The second was basically unsound because, under short-circuit conditions, the circuit breaker is slower acting than the fuse. Hence, if fuse did not have adequate interrupting capacity, it would blow up before breaker could operate to protect it.

By 1947, field experience on dual-element fuse had been so satisfactory that complete interrupting-capacity provisions were mandatory. Unfortunately, it was practically impossible to find 240- or 480-v circuits with sufficient capacity for determining interrupting capacity of dual-element fuses. In last several years such a circuit was made available and knowledge gained by tests on it made possible redesign of the fuse, increasing its interrupting capacity. Paper describes results of this development, giving actual test data on fuses commercially available today for protecting steel-mill power circuits. *AISE paper. No number.*

Consideration in the Use of Smaller Instruments and Their Relation to Centralized Control. *By E W Jenkins Jr, Leeds & Northrup Co.*

Panel-mounted devices, including operating instruments, indicating and recording devices, and their type, size and location, with particular regard to the various approaches available to reduce panel space are discussed.

Each panel-mounted device is classed according to its basic functional group, such as operating, indicating, recording.

First step in reducing panel size is to eliminate as many of the instruments appearing on the panelboard as possible. This elimination may be achieved by improving design of the apparatus or control equipment so there is no longer any need for indication at a central place. Second procedure is to locate the devices elsewhere. In this way, certain recorders can be mounted near the equipment and their information retransmitted to a much smaller indicator on an operating panel. *ASME paper No. 51-SA-46.*

An Engineering Approach to Control Room Lighting. *By C L Dzwonczyk, American Gas & Electric Service Corp.*

There is no method, based on lighting standards alone, to illuminate a control room correctly. The search for a reasonable solution has prompted the author to work up a study of the fundamental requirements affecting the problem. Major objectives, as he sees them, are (1) a lighting system that helps the operators perform their visual tasks more efficiently (2) possibility for any desired refinements to be made later.

Since the arrival of the fluorescent lamp, the preferred control-room lighting arrangement falls into two major systems: The luminous ceiling design or the direct system. The major problems that arise are getting vertical illumination on the instrument board so it gives quick, comfortable visibility and yet diffuses the light enough to hold shadows on instrument scales to the lowest possible rate of incidence. Further, the light sources should not appear as spots or create glare on the instrument cases from the operator's usual working position. Nor should the light sources act as brightness areas.

Since the operating room is the nerve center of the entire plant, it is desirable that service be assured. For this reason, emergency lights in the author's plant are of incandescent design and arranged so they are normally out. They are automatically switched to the station battery if the ac source fails. In addition, provision is made to test light sources periodically. Emergency lights are strategically placed around the control room and integrated with the general board lighting scheme. *AIEE paper No. 51-157. From AIEE, 33 W 39 St, New York 18, N.Y.*

Ac Power Distribution in Steel Mills. *By D L Beeman, General Electric Co.*

Progress in design of ac power sys-

(Continued on page 226)

TO OBTAIN COMPLETE TEXT

Material for these abstracts came from one of the following sources unless otherwise stated. Order complete paper from source, not from POWER.

American Society of Mechanical Engineers, fall meeting, Radisson Hotel, Minneapolis, Minn., Sept 26-28, 1951. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

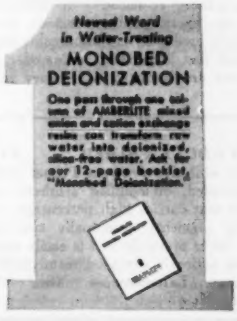
Association of Iron and Steel Engineers, annual meeting, Hotel Sherman, Chicago, Ill. Oct 1-4, 1951. Identified by initials AISE and obtainable through AISE as reported in the Iron and Steel Engineer, *1010 Empire Bldg, Pittsburgh, Pennsylvania.*

ASSURED SUPPLY OF HIGHEST QUALITY BOILER FEED WATER—WITHOUT EVAPORATION

Raw water analyses often vary widely—from season to season and even from day to day. So may the demand for treated water in a modern power plant. AMBERLITE Ion Exchange Resins quickly solve both problems—give you the water you want from the water you have—*without the use of evaporators.*

An adequate supply of highest quality, conditioned water is assured with AMBERLITE Ion Exchange Resins. Even when dissolved solids in the raw water are at a high level and peak output is required, ion concentration of the treated water can be maintained at 0.1 p.p.m. or less. Silica, carbon dioxide and hardness are almost completely eliminated, often in *one* pass through *one* exchange column.

For details about low-cost, *silica-removing deionization*, send for our bulletin on AMBERLITE Ion Exchange Resins. Then discuss the AMBERLITE process with your consulting engineer or water conditioning equipment supplier. He'll be glad to help you choose the multiple-bed installation or Monobed unit that suits your specific needs.


Newest Word
in Water-Treating
MONOBED
DEIONIZATION
One pass through one column of AMBERLITE mixed anion and cation exchange resins can transform raw water into deionized, silica-free water. Ask for our 12-page booklet, "Monobed Deionization."

AMBERLITE is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers

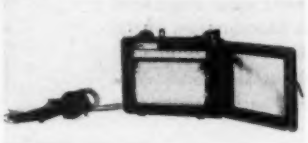
RECORDING CLAMP-ON AMMETER SPOTS TROUBLE P1257

New *TAG-Weston* combination (recording ammeter and clamp-on unit) reveals proper or improper handling of plant equipment, detects unwarranted use of power, and discovers unnecessary waste of production line time by checking starting and ending time of operating equipment. Clamp sensing element transmits findings to recorder. Chart can be removed for permanent filing.

Modified Weston model 633 clamp unit can make rapid ac measurements on either insulated or non-insulated conductors. It functions on the magnetic induction principle. Trigger-action clamping jaw is hooked onto conductor and current is induced in a winding on magnetic circuit of clamping jaw. By means of a rectifier network, induced ac becomes dc and is supplied to the recording ammeter.

Can be used with extension cable several hundred feet long. The laminated clamping jaws are insulated with heavy rubber sleeve that withstands breakdown test of 5000 volts ac, and can accommodate conductors up to 2-in. dia.

When used on commercial sine wave of frequencies between 50 and 70 cycles, instrument has accuracy within 3%. Effect of position of the conductor is included.



For permanent installation, recording ammeter is used with the Weston rectifier converter, model 9921 and current transformer, model 604, type 2.

Tagliabue Instruments Div, Weston Electrical Instruments Corp, 614 Frelinghuysen Ave, Newark, N. J.

HEAVY-DUTY PRIMER P1223

Rust-inhibitive *Prufcoat* Primer P-50 is heavy-bodied, oil-modified synthetic resin vehicle that carries high percentage of inhibitive pigments, principally zinc chromate. Dries overnight and is easily applied even to seriously corroded metal surfaces.

Prufcoat Laboratories, Inc, Cambridge, Mass.

CORROSION PREVENTION P1227

Slightly volatile amine nitrate crystals, known as VPI, give off vapors that reach all surfaces of a metal by convection and diffusion. They condense, providing a thin layer that protects metal against the corrosive action of air. For best application metal parts to be coated should be placed within two feet of the powdered VPI and inside a closed area.

Shell Oil Co, 50 W 50th St, New York 20, N. Y.

RESISTANCE DECREASES WITH TEMPERATURE P1258

Thermistors—thermally sensitive resistors—were announced at Metals Show in Detroit as now in "engineering appraisal" stage at Carboloy Dept, General Electric Co. Metal ceramics used for *Thermistors* act exactly opposite to conventional metals as to electrical conductivity when temperature changes.

Electrical resistance of *Thermistors* decreases sharply with increase in temperature. One grade for instance, has resistance of only a little over 1/100th ohm-inch at 600 F but 2000 ohm-inches at – 50 F. A second material ranges from 1/10th ohm-inch at 600 F to 20,000 ohm-inches at – 50 F.

Small in size, thermistors because of their unusual non-ohmic characteristics may be used to replace highly intricate apparatus. Since they are pure electronic conductors, either dc or ac may be used.

They appear especially adaptable as the sensitive elements in flow meters, liquid level indicators and controls, time delay relays, voltage regulators, vacuum gages, switching devices, and other types of indicators and controls.

Carboloy Dept, General Electric Co, Detroit 32, Mich.

STEAM SCRUBBER P1220

Dry steam scrubber and purifier with 2-stage separation can deliver vapor holding only 1.0 ppm or less of solids. Rectangular-shaped, anti-turbulence shield prevents turbulent liquids and sprays from reaching secondary separation chamber. The shield is a four-wall chamber with off-set corners and overlapping side plates. Vapor passes around these side plates and into secondary chamber.

Secondary separation takes place in either upflow or downflow purifiers. Centrifugal and centripetal forces pull out remaining moisture. Entire assembly fits into distributing pan or header within a steam drum.

Centrifix Corp, 3608 Payne Ave, Cleveland 14, Ohio

PLASTIC BLOWERS P1261

Plastics replace critical aluminum and bronze for blowers in small, totally-enclosed, fan-cooled ac motors. Plastic blowers consist of a polyester-resin reinforced with glass fibers.

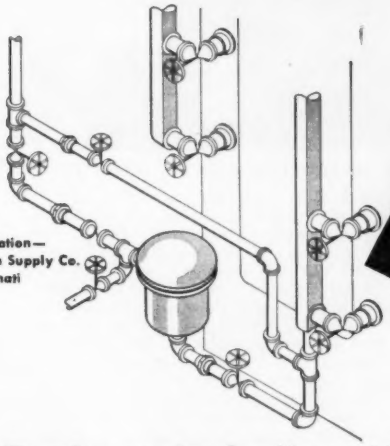
Plastic blower has many advantages. It is unaffected by chemical agents. Hence, it is desirable on motors used in refineries, chemical plants, and process industries. It is as much as 1/3 lighter than its metal counterparts. This reduces inertia. Blower has successfully passed overspeed tests at four times normal speed. Currently used

For more data on these items, use post cards, p171. Identify request with P and number.

for outstanding service

on Heavy-Duty Steam Drying Units

...for example



The installation—
American Linen Supply Co.
Cincinnati

PROBLEM: To equip a steam-heated tumbler-type drier with a trap that would reduce start-up time to a minimum, and provide, automatically, a smooth, steady flow of hot, dry steam to the unit, with the lowest possible maintenance cost.

WORKING CONDITIONS: Steam pressure to drier, 125 pounds. Drier operated 16 hours daily on continuous batch basis.

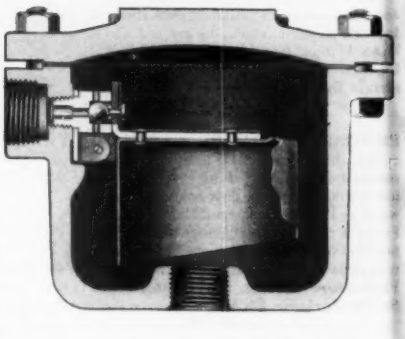
SOLUTION TO PROBLEM: Crane No. 981, ¾-inch, 150-Pound Inverted Open Float Trap, carefully selected for adequate drainage capacity, and properly installed. (Now listed as No. 9810, with patented improved ball-type disc.)

RESULTS: Never requiring any repairs or new parts in more than 8 years' service, this Crane trap has given complete satisfaction. Periodic routine inspection only is total maintenance cost.

...ANOTHER TYPICAL CASE HISTORY demonstrating the better performance... the lower ultimate cost of Crane Valves of all types... and why—

More Crane Valves are used than any other make!

Rely on Dependable CRANE STEAM TRAPS



Crane Inverted Open Float Steam Trap with patented ball-type disc, for 1 to 300 pounds saturated steam working pressures. Literature on request from your Crane Branch or Crane Wholesaler.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 162

in totally-enclosed fan-cooled life-line motors in NEMA frames 254 and 284 (5 and 7½ hp, 1750 rpm).
Westinghouse Electric Corp, 306 Fourth Ave, Pittsburgh 30, Pa.

DUCT FURNACES P1228

Durable one-piece cast iron heat exchanger and combustion chamber can be put in ducts of air conditioning system for local heating. Built-in draft hood absorbs all chimney action and conserves heat. Sizes from 12,000 to 200,000 Btu input per hr. Furnaces are shipped completely assembled with controls and built-in draft diverter. AGA tested and approved at 2 in. w.g. pressure.
Automatic Gas Equipment Co, 550 Brushton Ave, Pittsburgh 21, Pa.

CORD AND PLUG SET P1246

8-ft cord set has molded-on plug with special round pin to provide positive third-wire grounding. Grounding pin is integral part of the plug and requires no secondary operation of attaching grounding lead or strap.

Contacts are heavy-duty tinned solid brass and conductors are No. 16 AWG, stripped for ease of installation. Jacket is ribbed-finish 3/16-in. type SJ rubber.
General Electric Co, Construction Materials Dept, Bridgeport, Conn.

PROTECTIVE COATING P1230

Fast drying, protective coating, *Tarlac*, results from breaking down coal tar pitch into minute particles, then combining with water and a stabilizing emulsification agent. Forms a permanent suspension that can be brushed or sprayed. Does not crack at low temperature or run at high temperature.
Flash-Stone Co, Inc, 30 E Rittenhouse St, Philadelphia 44, Pa.

LIQUID MEASUREMENT P1218

Complete line of porcelain-enameled steel-staff gages for water, sewage and other liquid measurements is said to be impervious to rust, discoloration, other deterioration even with a high acid content. Available in variety of sizes with ratings in ft, tenths and hundredths of ft for depth measurement, and with graduations in cfs for flow measurement over weirs or Parshall flumes.
Porcelain Enamel Institute, 1010 Vermont Ave, N.W., Washington 5, D.C.

TEMPERATURE MONITOR P1237

An electronic scanning system automatically and continuously monitors up to 270 separate processing temperature points. Records only temperatures that deviate beyond pre-set limit. Audible alarm permits immediate correction of excess temperatures, and replaces several instruments and time-taking logging operations.

Suitable for steam generating stations and in the manufacture of synthetic fibers and yarns where temperature of feed material supplying spinnerettes must be maintained at specific levels. Also has application in chemical, petroleum and other processing industries.
Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Wayne & Windrim Ave, Philadelphia 44, Pa.

GAS ANALYZER P1229

Thermocouple-type analyzer and a potentiometer make gas analyzer that eliminates many difficulties caused by zero drift. Detects leaks or dangerous concentrations of combustible gases in industrial processing.
Brown Instrument Div, Minneapolis-Honeywell Regulator Co, Wayne and Windrim Ave, Philadelphia 44, Pa.

THIN WEAR-PROOF CARBIDE COATINGS

Soon you'll be able to coat metal parts with a relatively thin "skin" of ultra-hard, wear resisting, tungsten carbide. At least that's the promise Carboloy Dept of General Electric Co made in October at the World Metallurgical Congress and Metals Exposition in Detroit.

They've already completed basic laboratory development on a weldable tungsten carbide. Using conventional shielded electric-arc welding-equipment the material flows onto metal surfaces. With steel or iron surfaces it fuses and blends with the base metal to give a surface coating that is about 70% wear-resisting tungsten carbide. Result is a coat with 15 to 20 times the wear-resisting abilities of the best chilled cast irons of 43 to 67 Rockwell, on the basis of aluminum oxide dry abrasion test.

Several types of binders have been used in the experiments—iron, nickel, cobalt—but no final determination has been made on which binder works best on specific metals.

LAMP LOCK-GUIDE P1238

Lok-Gyde for fluorescent lamps performs two functions. It channels the terminal pins into the sockets in relamping, making lamp replacement a one-hand job. It then locks lamp in sockets.

Device reduces time required for lamp replacement, minimizes hazards of relamping, and guards against danger of lamps falling if dislodged by vibration. Attachment is quickly slipped over any standard 15- to 40-w fluorescent socket.
Edison Electrical Co, 355 Weybosset St, Providence 3, R. I.

CONDENSING FILTER P1214

Compressed air line filter, the *Airlenco*, also functions as condenser because of its extra size and extended surface. It has a steel outer shell, 6 in. dia; 36 in. long with a 5-in.-dia inner steel cartridge, 24 in. long, loosely packed with Fiberglas. A cast-aluminum head with inlet and outlet openings bolts to a flange welded on outer shell. Fiberglas baffles out any entrained moisture or oil as air passes through it. Only main-

For more data on these items, use post cards, p171. Identify request with P and number.

Perhaps we can give YOU a HELPING HAND

● Under present conditions we cannot always give you all the materials you require. But we can give you plenty of help through Revere's Technical Advisory Service. And, our colleagues in American business tell us it's a worthwhile aid, too. We have been rendering this service for many years, and it is backed by a wealth of knowledge accumulated over a century and a half of working with metals.

So, with your problems on the increase, as whose aren't these days, why not check us on what's bothering you and see if we can't help. We are already helping others regarding the usage, to their best advantage, of the products they *can* get.

Since two or more heads can produce more right answers than one, let's get together. You can get in touch with the Revere Technical Advisory Service through the Revere office nearest you.

REVERE 150th YEAR OF SERVICE TO AMERICA

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Begins on page 162

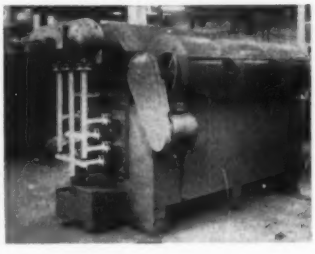
tenance required is draining out the moisture collection from time to time.
Air Line Engineering Co, 4758 Warner Rd, Cleveland, Ohio

PRECISION SPEED CONTROL P1255

Regutron magnetic amplifier control is used with E-M adjustable-speed magnetic drive. Latter is electromagnetic torque transmitting device that gives variable speed output when used with constant speed motor.

Control eliminates all complicated electronic circuits of previous electronic-type amplifiers. Simple saturable-core reactor amplifier system using non-moving parts gives precise, stepless control of speed within ± 0.5%. Current amplification ratio is approximately 20,000 to 1.

All components are reliable, time-proven devices, and conservatively-rated parts should last for years with little change in characteristics. Adjustable-speed magnetic drives have ratings 25-hp and higher in usual motor speeds. Useful for fans, centrifugal pumps, and centrifugal compressors.
Electric Machinery Mfg Co, Minneapolis 13, Minn.



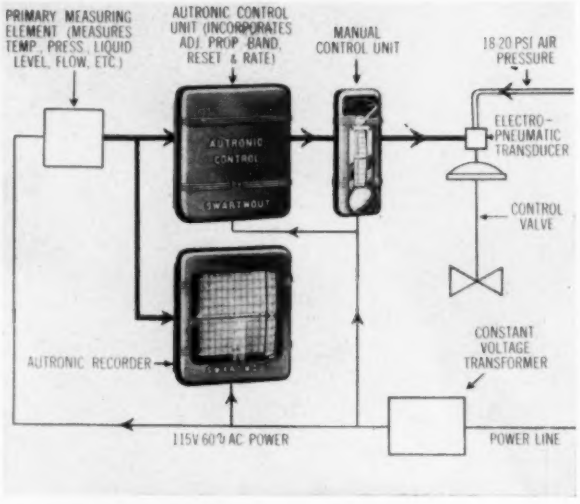
SPRAY COOLER P1211

Improved *No Frost* spray cooler differs from previous models—air enters through fans, is blown through the units. It passes over refrigeration coils and through a spray of *No Frost* liquid solution that prevents condensation of water and formation of ice or frost on the coils. Chilled air, which may be as low as –20 F, passes direct from spray chamber into the room. It contains no reheat from the fans.
Niagara Blower Co, 405 Lexington Ave, New York 17, N.Y.

SEAMLESS TUBING P1234

Seamless cast polyethylene tubing, *Agilene*, has diameters from 2¾ to 20 in., standard wall thicknesses to 2 in. Chemically inert. Individual lengths can be joined in leak-proof manner by hot gas welding.
American Agile Corp, 5806 Horigh Ave, Cleveland 3, Ohio

For more data on these items, use post cards, p171. Identify request with P and number.



MEASURING AND CONTROLLING PRESSURE LEVEL, FLOW P1236

Centralized-control, miniature, all-electronic system for measuring and controlling process variables like temperature, pressure, level and flow. *Autronic* control system has three basic units: primary sensing element, *Autronic* control unit, and final control element. Powered by 115-v, 60-cycle ac.

Primary sensing element generates voltage that is directly proportional to any change in process variable. This voltage, always within the same range, is transmitted to the *Autronic* control. Here it is continuously modulated by electronic means and resulting dc is transmitted to the final control element, which may be either electrically or pneumatically operated.

Electrical transmission is used; hence no transmission lag. A recorder can be plugged into the circuit. Unit has independent chart drive and spools permit inspection of past records without interruption of pen track. Manual controller also available.
The Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio

SYNCHRONOUS MOTOR P1254

Motor operates on reluctance principle, has no brushes, slip rings, rotating coils or permanent magnet. Can operate continuously at any voltage below 250, either single phase or polyphase. For control system instrumentation, and industrial equipment.

Typical motor is 4 in. in dia by 2⅝-in. long, weighs 2.6 lbs, develops 8 oz-in. starting torque and 0.8 in. synchronous torque.
Allis-Chalmers Mfg Co, General Machinery Div, Milwaukee 1, Wis.

GAGE-GLASS GASKET P1210

Red-rubber gage-glass gasket is designed for extreme temperature and working pressures to 600 psi. Fits all water-gage stuffing boxes where round tubular glasses are installed. Has many other applications. Gasket won't blow or soften.
Ernst Water Column & Gage Co, Livingston, N.J.

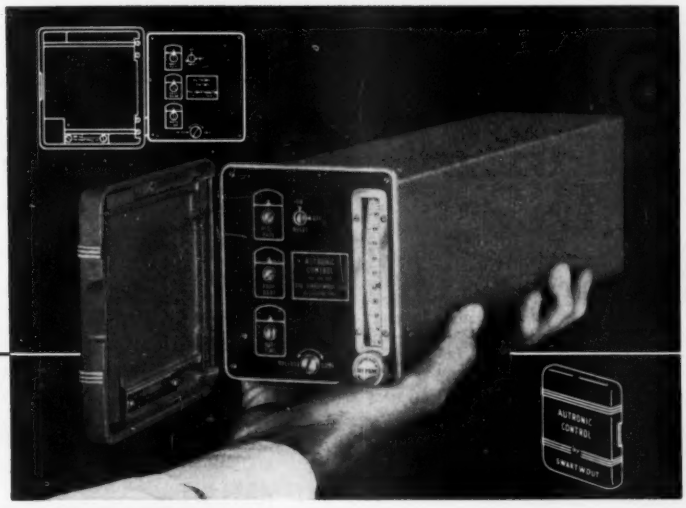
TRANSFER SWITCH P1251

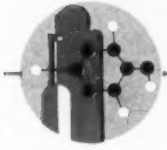
Alternate-contact-operating switch useful for machine tools; circuit transfer to timers and recording equipment; safety circuits; and as a limit switch. Operates so that first press transfers the contacts; second press restores them.

Single-pole, double-throw contacts permit adaptation to either normally closed or normally open circuits. Mounting is either in single hole by ½-in. threaded bushing, or top or side panel with clearance holes for 6-32 screws. Overall dimensions are 2-in. wide, 2 25/32-in. high including plunger, 1 3/32-in. deep. Contacts are rated at 20 amp, 125 volts ac, non-inductive.
General Control Co, Boston 34, Mass.

INSULATION TESTER P1240

High voltage dc insulation test unit to detect insulation weaknesses before breakdowns occur. Instrument tests at over or under full operating voltage of the equip-





accurate . . . instantaneous

all-electronic instrumentation

• No matter how fast a pneumatic or electro-mechanical control system may function, it cannot compare with the *instantaneous, all-electronic response of the Swartwout Autronic Control System.*

Heart of the system is the compact, plug-in type Autronic Controller. All-electronic operation means it has no mechanical motion whatsoever . . . no slide wires, boosters or motors to initiate control action . . . no air lines from the measuring element or to the final element. Hence the Autronic Controller eliminates all transmission lags . . . spans distance between primary and final elements *without interval.* Accurate, positive calibration gives the Autronic Controller complete interchangeability . . . eliminates any need for recalibrating, adjusting or trimming.

Call in our engineering representative to explain how the Autronic Control System can bring new accuracy to your process or power instrumentation. Or write *today* for literature on the new Swartwout Autronic Control System. A-4710

Swartwout *Autronic* **CONTROL SYSTEM**

SEND FOR BULLETIN A-701 • THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12, OHIO

More EQUIPMENT NEWS

Begins on page 162

ment under test; will not impair value of insulation. Called the *Takk* high voltage dc insulation tester, it's manufactured for ranges of 0-15, 30, 45 and 75 kv.

The John Hewson Co, 106 Water St, New York 5, N. Y.

DAYLIGHT INTENSITY RECORDING UNIT P1239

Suitable as a remote reporter to utility load dispatchers in anticipating lighting load changes. Provides accurate, automatic means for recording daylight intensity directly in footcandles. Cell unit and recorder operate together as a calibrated assembly.

The cell, for mounting atop a mast or in any dominant location, is a refined version of a U.S. Weather Bureau design, tested in field service. Using a barrier-layer photocell, the assembly is designed for collecting total illumination of sun and sky, and for filtration to match the photocell spectral response to the mean visibility curve of the human eye.

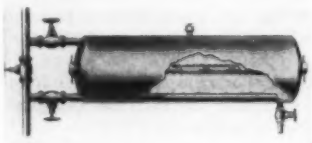
Cell may be several hundred feet distant from recorder.

Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

MEASURING LOW VOLTAGE P1252

Narrow-span potentiometer instruments make accurate measurements of dc potentials in microvolts. For laboratory investigations and production line measurements of low potential signals. Instruments are also useful (with appropriate primary measuring elements) for precise measurement of differential temperatures, and of slight variations in temperatures of small objects, by using radiation pyrometry.

Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Wayne & Windrim Ave, Philadelphia 44, Pa.



ELECTROLYTIC PROTECTION P1224

Catalytic action of this method of water treatment does not change chemical structure of the water. Prevents formation of new scale and gradually removes old scale. Dispersion of elements that have affinity for forming scale and corrosion produces the results.

Sola Catalytic Co, 520 Browder St, Dallas 1, Tex.

For more data on these items, use post cards, p171. Identify request with P and number.

HEATING CONTROL P1231

Modulating, completely adjustable, heating system control, *Weather-Flo*, takes an outdoor weather reading and combines it with indoor temperature reading. Changes heat supply in anticipation of needs. Built-in fan or pump switch provides continuous regulated flow of heat. Gives constant, uniform heating level at desired temperature.

Automatic Devices Co, Inc, Western Spring, Ill.

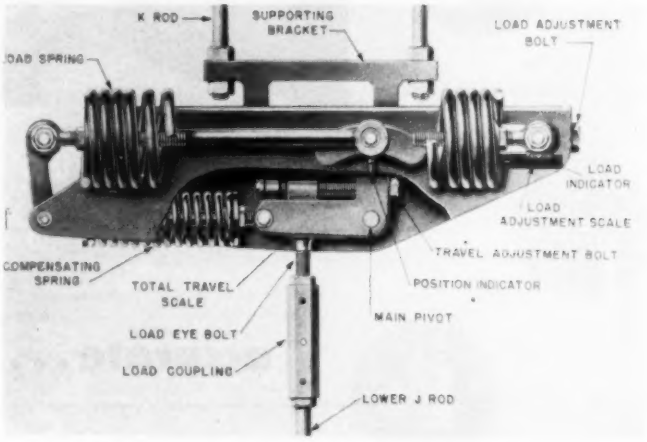
Now Take Another Minute To Check These . . .

Oil Filters up to 1000 gpm ..... p 188

Metallizing Gun, high speed ..... p 192

Sump Pump completely submersible p 196

Stethescope locates machine noises p 202



CONSTANT-SUPPORT PIPE HANGER USES FEWER SPRINGS P1209

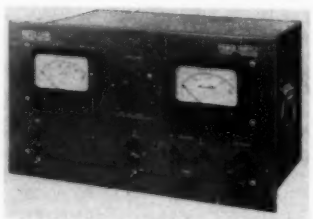
Model L constant-support hanger has simplified field adjustment, increased travel range and greater load capacity with a smaller number of springs and fewer chassis sizes. Maximum travel in the medium chassis is 5 in., in the large chassis, 10 in. Hanger gives equal lift in all positions of travel of a piping system for movement between hot and cold positions. Sixteen sizes cover the total load range, which formerly required 28 sizes.

As load capacities and travel ranges increase from size to size there is complete overlapping of load and travel ranges. So for every load there is a *Model L* hanger with an appropriate travel range or a choice of travel ranges.

Differences between calculated hanger loads and actual loads are simple to correct in the field at time of installation. Only one nut need be adjusted whereas in former models three adjustments had to be made.

New *Model L* provides lift that more nearly approaches the ideal of constancy. Transfer of stresses in piping system is thereby further minimized. Simplifies selection for the engineer writing specifications.

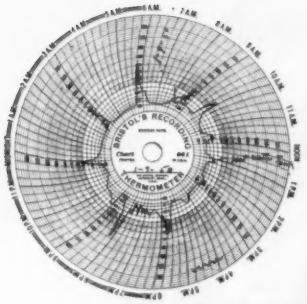
Grinnell Co, Inc, Providence, R.I.

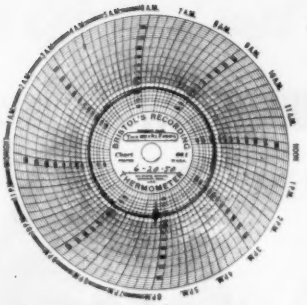


REGULATED POWER SUPPLY P1243

Model 1020 features a regulated high-voltage power supply with low ripple content, and low output impedance. High-voltage supply is continuously variable from 0-1000 volts and delivers from 0-50 ma. In the range 100-1000 volts, output voltage variation is less than 0.1% for both line fluctuations from 105-125 volts and load variation from minimum to maximum current. 6.3 v, 10 amp ac output included.

(*Continued on page 176*)





(Charts showing customer's hot water storage tank operation.)

ONE DAY BEFORE **TWO WEEKS WITH SQUIRES**

Proof of Positive Performance

WITH A

SQUIRES COMBINATION TEMPERATURE & REDUCING VALVE

RUGGED SEATS & DISCS

Maintenance is low because SQUIRES seats and discs can take punishment. Several materials are available including Age Hardened SQUIRALLOY for extreme conditions.

1 DEGREE TEMPERATURE CONTROL

SQUIRES Temperature Pilots give this control for either temperature regulators or Combination Pressure and Temperature Regulators.

PACKLESS VALVES

SQUIRES valves available in packless construction through 3".

"STRENGTH WITHOUT STRAIN" IN PATENTED DIAPHRAGM

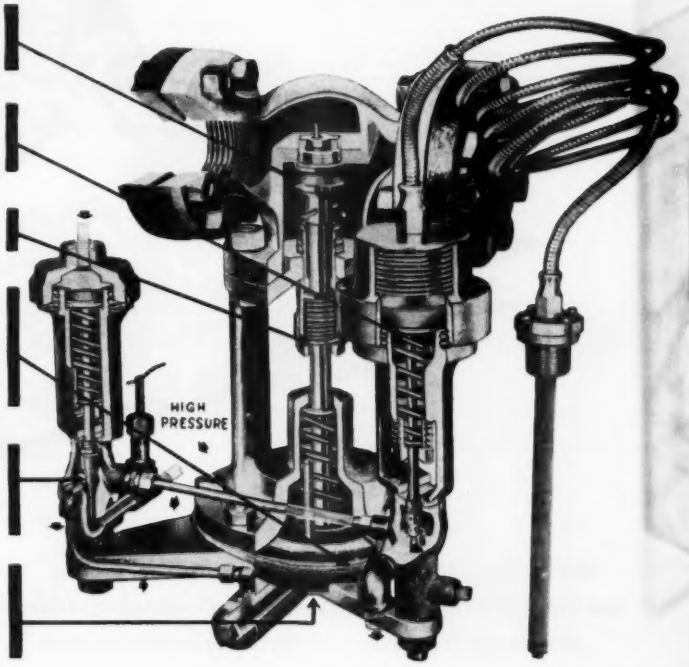
Only in SQUIRES do you get a composition rubber diaphragm protected by 2 brass diaphragms. Thus, you get the flexibility of rubber combined with the durability of brass for years of dependable trouble-free operation.

PRESSURE CONTROL WITHIN OUNCES

The heart of accuracy in SQUIRES Reducing Valves lies in the Pilot Resistance Plug. Large Valve area at the top gives quick opening of main valve when necessary. Small bleed around stem cushions valve closing and sensitizes control.

POSITIVE DEAD-END CONTROL

Only in SQUIRES Patented Valves does full High Pressure dead-end the main valve. For example, 100 lb. of initial pressure through the Pilot Resistance Plug in the 1¼" valve shown, makes 3,000 lb. of force available on the main diaphragm for dead-ending the valve.



In the SQUIRES Combination Valve illustrated above, the Temperature Pilot is connected in series with the Pressure Pilot. It maintains a constant temperature at all times and holds the reduced pressure to a predetermined maximum. With just *one* SQUIRES Combination Valve, steam pressure can be reduced from 600 lb. initial pressure to ounces in just one step. At the same time, as shown in the charts above, temperatures are maintained to within 1 degree plus or minus.

These are some of the main reasons why SQUIRES Valves are your best investment—initially and in the years to come. Get the full facts *today* by writing. Ask for Bulletin #103-A.

THE C. E. SQUIRES COMPANY

Over 50 Years of Dependability

18511 SYRACUSE AVENUE • CLEVELAND 10, OHIO

"Tycol Aturbrio · resists heat and sludging... turbines operate for years without shutdown"

Correct! Tycol Aturbrio Oils resist emulsification, foaming and deterioration even when turbines operate continuously. Oiling systems stay clean longer—uninterrupted service is assured.

Tycol Aturbrio Oils are "double inhibited" to give utmost rust and oxidation resistance. They keep costs down... hold wear to a minimum.

For further information, get in touch with your nearby Tide Water Associated office. Write or wire today.

TYCOL

INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh
Philadelphia • Chicago • Detroit
Tulsa • Cleveland • San Francisco

TIDE WATER ASSOCIATED OIL COMPANY

17 BATTERY PLACE · NEW YORK 4, N. Y.

SEND FOR A FREE COPY OF "TIDE WATER ASSOCIATED LUBRICANIA"

Keep Up To Date...
Send In These Cards For...

- **more information about NEW PRODUCTS on preceding pages**
- **copies of these new . . .**

FREE CATALOGS AND BULLETINS

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

B1 **ROOF VENTILATOR**—Straight-through type, 16 to 60 in. 1/6 to 20 hp, 1950 to 70,300 cfm. Diagrams, photos, dimensions. 2-page bulletin No. 346. The Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

BOILERS AND AUXILIARIES

B2 **STEAM GENERATORS** — Packaged construction and operation. Photos, cut-away schematics, charts for data, dimensions, specifications, test results. 20 to 600 boiler hp, 700 to 20,700 lbs steam per hr at 212 F. 16-page catalog with fold-out cover. Superior Combustion Industries, Inc, 1475 Broadway, New York 18, N. Y.

COMPRESSORS AND ACCESSORIES

B3 **ROTARY COMPRESSORS**—With eccentrically mounted rotor. 4-page bulletin No. C-6 has diagrams, installation photos, gives principles of operation. FullerCo, Fuller Bldg, Catasauqua, Pa.

ELECTRICAL AND MECHANICAL CONTROLS

B4 **pH AND CONDUCTIVITY RECORDERS AND CONTROLLERS** —Covers pH, oxidation-reduction potential, electrolytic conductivity. Operation, applications, specifications, dimensions, photos, descriptions. 40-page revised catalog No. 15-16. Minneapolis-Honeywell Regulator Co, Brown Instrument Div, Station 40, Wayne and Windrim Ave, Philadelphia 44, Pa.

B5 **LOAD-BREAK OIL SWITCHES** —Type "RA" for 400 amp, 600, 7500, 15,000 and 23,000 volts. For primary distribution systems. 44-page bulletin No. DB-51. Construction details, photos, diagrams, dimensions. G & W Electric Specialty Co, 7780 Dante Ave, Chicago 19, Ill.

B6 **ELECTRIC CONTACT CONTROLLERS**—Vane type. 2- or 3-position, control, 2½ to 30 amps. Used with thermometers, pressure gauges, potentiometers and millivoltmeters. Charts, dimensions. 16-page catalog No. 8000. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne and Windrim Ave, Philadelphia 44, Pa.

B7 **CHRONOFLO TELEMETER** — Distance transmission of information and controls over 2-wire elec-

FILL OUT AND MAIL TODAY! NOT GOOD AFTER MAR. 1, 1952

Write in here the black numbers printed at the beginning of items you want ➡

These numbers start with the letter "P" Make sure you write the full number ➡

12/51

Send me these FREE Catalogs and Bulletins...

☐☐☐☐☐☐☐☐☐☐☐☐

I want details on these New Products...

☐☐☐☐☐☐☐☐☐☐

My Name .....

Title .....

Company .....

Address .....

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

FIRST CLASS
PERMIT No. 64
(Sec.34.9,P.L.&R.)
NEW YORK,N.Y.

4c Postage Will Be Paid by—
POWER
330 West 42nd Street
New York 18, N. Y.

More FREE LITERATURE

Begins on page 171

trical circuit. Measurement of flow of liquids and gases, proportional control of feeds, pressure and temperature telemetering. Photos and diagrams. 8-page bulletin No. 230-H4. Builders-Providence, Inc, 354 Harris Ave, Providence 1, R. I.

B8 **POSITIONING CONTROL**—*Rotomotor*, pneumatic gear-driven operator for heavy-duty service. Dimensions, operation methods, applications. 8-page bulletin No. C-1. Conoflow Corp, 2100 Arch St, Philadelphia 3, Pa.

B9 **LIQUID LEVEL CONTROLLERS** —Internal and external float cages. Ratings 125 to 300 lb. Dimensions, construction, photos, Specification sheet No. 412-2. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne and Windrim Ave, Philadelphia 44, Pa.

B10 **CONTROL EQUIPMENT** — Thermostats, motor-operated valves and accessories for heating, ventilating and air conditioning. Photos, dimensions, selection charts. Control catalog No. F-1753-3. Barber-Colman Co, Rockford, Ill.

B11 **HYDRAULIC REMOTE CONTROLS** — Single-tube balanced system, no outside source of power. Capacity to 400 in-lbs on pressure stroke, 125 in-lbs on return stroke. 4-page bulletin No. 20-106. General description, operating principles, diagrams, photos. C E Hohl, Sales Engineer, Sperry Products, Inc, Danbury, Conn.

ELECTRICAL EQUIPMENT

B12 **POWER-CONVERSION UNITS** —Metallic rectifier type. 0.75 to 25 kw at 250 and 125 volts dc. Specification guide for dc power supplies and exciters. Photos, drawings and efficiency charts. 8-page booklet No. GEA-5653. General Electric Co, Schenectady 5, N. Y.

B13 **CAPACITORS** — Fixed paper dielectric types. Description, application, tables of prices and data. 16-page booklet No. GEC-809. General Electric Co, Schenectady 5, N. Y.

B14 **FLUORESCENT LAMP BALLASTS**—20-page non-technical review of ballast use and history, booklet No. GEA-5731. Also 4-page brochure No. GEA-5672 describing ballast soundrating. General Electric Co, Schenectady 5, N. Y.

★ **CABLE CONNECTORS** — Solderless pressure type. Lists 3 lines of fittings for copper conductors from No. 14 through 2,000,000 circular mils. Photos, drawings, dimensions. 56-page bulletin No. 66. ★Write direct, on company letterhead, to The Thomas & Betts Co, Inc, 46A Butler St, Elizabeth, N. J.

B15 **VERTICAL INDUCTION MOTORS**—From 60 hp at 200 rpm to 800 hp and larger at 1800 rpm. Data on ratings, construction and types. 4-page bulletin No. 05B7629. Allis-Chalmers Mfg Co, 932 S 70th St, Milwaukee, Wis.

B16 **TOTALLY - ENCLOSED MOTORS**—With air-to-water heat exchangers. 4-page bulletin No. 05B7682 gives construction, cooler arrangements and water-requirement estimation. Allis-Chalmers Mfg Co, 932 S 70th St, Milwaukee, Wis.

B17 **PROTECTIVE LIGHTING** — Complete plans for outdoor industrial lighting with power distribution, control systems, mounting methods. 24-page booklet No. B-4791. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

B18 **LINEAR TRANSDUCERS** — Differential transformers measure motion from a few micro-inches to 5 in. Generate ac voltage signal proportional to armature position change. Operation, stock types, electrical data. Data sheets No. 55 and 56, and wiring diagram. Automatic Temperature Control Co, Inc, 5200 Pulaski Ave, Philadelphia 44, Pa.

B19 **SYNCHRONOUS MOTORS** — Low-speed, coupled-type pedestal-bearing motors, 100 hp and larger at 450 rpm or less. 1.00 power factor or 0.8 or better leading power factor. 6-page bulletin No. 05B7648. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

B20 **SCREEN-BOOTH FILTERS** — For electronic noise-suppression. Remove high-level interference from electrical power-distribution circuits. Light, medium or heavy-duty. Catalog No. 201 gives dimensions, specifications. Tobe Deutschmann Corp, 921 Providence Hwy, Norwood, Mass.

INSULATION, HEAT, COLD AND VIBRATION

B21 **INSULATION MATERIALS**—*Thermalite* 85% magnesia insulation for pipe covering and equipment. 8-page bulletin No. 4h gives recommended thicknesses, characteristics, table of insulating cements, photos. Ehret Magnesia Mfg Co, Valley Forge, Pa.

MAINTENANCE AND SAFETY EQUIPMENT

B22 **DRUM CLEANERS**—Rotoblast blast machines clean 70 and 140 drums per hr. Photos, drawings, dimensions. 6-page bulletin No. 220. Pangborn Corp, Hagerstown, Md.

B23 **MINIATURE CATALOGS**—Accordion-folded catalogs of machine tools and lathe accessories; 2½ by 1⅝ in., 28 pages each with illustrations. Catalog Nos. 5104 and 5119. South Bend Lathe Works, South Bend 22, Ind.

B24 **HYDRAULIC VISE**—4-in jaw with 6-in opening. Max jaw pressure 4000 lb, max hydraulic pressure 7000 psi. Foot pedal control. Specifications, parts list, diagrams, photos. Bulletins No. HV 7548-R and 6042 SPS. Columbian Vise and Mfg Co, 9021 Bessemer Ave, Cleveland 4, Ohio.

B25 **PACKINGS** — Asbestos fabric in ⅜ to 2 in. sizes. Types, service recommendations, sizes, std packages; 4-page bulletin. Raybestos-Manhattan, Inc, Packing Div, Manheim, Pa.

B26 **MORTAR**—*Embeco* Method for Setting Floor Brick. Description, photos, diagrams, applications for brick and heavy tile floors. 4-page bulletin. The Master Builders Co, 7016 Euclid Ave, Cleveland 3, Ohio

B27 **PAINTS** — 4-page technical folder with quick reference index of most suitable coatings for rust prevention, chemical corrosion, and dampness. The Wilbur & Williams Co, 130 Lincoln St, Brighton 35, Mass.

B28 **PAINTS**—Anti-rust in black and clear colors. Prices included. 1-page bulletin No. L-4284. Paint Corporation of America, Fidelity Bldg, Cleveland 14, Ohio.

B29 **SEALING AND LUBRICATION COMPOUNDS** — 12 different compounds for thread sealing and valve lubrication, some specialized mixtures. Catalog No. 5400. Parker Appliance Co, 17325 Euclid Ave, Cleveland 12, Ohio.

B30 **LUBRICANTS** — Two folders listing types and uses of *Lubriplate*. Fiske Bros Refining Co, Lubriplate Div, Newark 5, N. J.

B31 **WEATHERPROOF ASPHALT** —*Laykold Fibrecoat* for bitumi-

(*Continued on page 218*)

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

FIRST CLASS
PERMIT No. 64
(Sec.34.9, P. L. & R.)
NEW YORK, N.Y.

4c Postage Will Be Paid by—
POWER
330 West 42nd Street
New York 18, N. Y.

12/51

Send me these FREE Catalogs and Bulletins...

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

I want details on these New Products...

☐	☐	☐	☐	☐	☐	☐	☐

My Name .....

Title .....

Company .....

Address .....

FOR PERFORMANCE YOU CAN **BANK** ON

Operating economy *is* an important factor in the selection of steam generating equipment; but equally important is dependability. These two basic considerations are such well-known attributes of Superior Steam Generators that Superior units are repeatedly specified for public utilities, hospitals, industrial plants, and similar critical installations.

Superior Steam Generators are built to develop their maximum rated capacities at thermal efficiencies guaranteed to exceed 80% . . . not for a day, or a month, but for years to come.

You can ***bank*** on their savings due to operating economy . . . but, more important, you can ***bank*** on the dependability of Superior Steam Generators for years of trouble-free service.

FOR COMPLETE DETAILS, WRITE TODAY FOR THE NEW FULLY ILLUSTRATED CATALOG 401 . . .

Fully automatic. Burns gas, or oil, or both.
18 sizes ranging from 20 up to 600 b.h.p.
for pressures to 250 p.s.i. or for hot water.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

SUPERIOR
STEAM GENERATORS

Jake's Old Icebox

JACOB SCHROEDER WAS CONSIDERED the best butcher in our county when I was a boy. I can see him now, cleaver in hand, standing at his meat block . . . rosy cheeks, gray handle-bar mustache, straw hat on head, his fleshy figure wrapped in a crisp white apron. To fill each order, he'd open the massive icebox door, disappear inside and return with a side of meat. After hacking off a few pieces, he retraced his steps for the next customer.

Jake was bullheaded. New display boxes had been on the market for some time, but Jake wouldn't even talk to the salesmen.

"Loafer," he'd say, "For vy you don't get honest job und let me do my vork? Out mit you."

One busy Saturday a display-box salesman came in who had heard of Jake. He parked himself near the icebox door. Every time Jake went inside, the salesmen threw a nickel in after him. This went on for several hours. Finally Jake exploded.

"Dummkopf," he shrieked, "You crazy? For vy you throw money avay?"

"I'm only half crazy," answered the salesman, "because I only threw away one dollar and thirty-five cents so far this morning. But you've been throwing away hundreds of dollars for years by melting ice each time you open that big door."

That registered. In a few weeks Jake had a new display icebox.

Don't laugh at Jake's bullheadedness. I can show you plant after plant with many times more serious waste than Jake's old-fashioned icebox. Only trouble is that sales engineers, who have the latest equipment to solve such problems, often aren't allowed in those plants.

Why? Because many plants are owned and operated by stubborn people like old Jacob Schroeder.

George Edwards

Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

Dowell Service cleaned seven heat exchangers in 19 hours!

This refinery had 7 heat exchangers that were badly fouled. Minimum downtime for cleaning was a prerequisite to maintain production. Dowell Service removed 80% of the deposits from the process sides in only 19 hours. As a result the operating pressure drop through the system was lowered from 80 p.s.i. to 5 p.s.i. with an equally satisfactory drop in operating temperatures.

Dowell Service is the answer to the maintenance engineer's demand for *fast, efficient, economical* cleaning. Maintenance time and costs can be cut by applying Dowell Service to condensers, process towers, boilers . . . to nearly any type of industrial equipment. Dowell engineers fill the equipment to be cleaned with liquid solvents. These solvents are designed to clean places inaccessible to other methods. Costly dismantling is eliminated and downtime is shortened.

What's *your* cleaning problem? Dowell Service Engineers will be glad to consult with you on *better, faster* methods of cleaning your equipment. No obligation, of course. Dowell Service is as near as your telephone.

Other recent Dowell jobs:

Oil, water, algae emulsion removed from refinery circulating water system in only 6 hours.

•

Water side of 15 tube and shell condensers cleaned for refinery. After Dowell Service, gasoline left condenser 20° cooler than when condensers were mechanically cleaned. Chief engineer estimates Dowell Service paid for itself in approximately 12½ days.

•

Partially carbonized oil and grease caused trouble in five 150,000 lb./hr. boilers in a Southwestern refinery. Dowell Service removed the deposits from each boiler in a few hours.

CALL

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

New York 20	Buffalo 2	Kansas City 8	Mt. Pleasant, Mich.
Boston 16	Cleveland 13	Wichita 2	Hamilton, Ohio
Philadelphia 2	Pittsburgh 19	Oklahoma City 2	Charleston 27, W. Va.
Baltimore 18	Detroit 2	Houston 2	Salem, Illinois
Wilmington 99	Chicago 2	New Orleans 12	Borger, Texas
Richmond 19	St. Louis 8	Ft. Worth 2	Midland, Texas
Jacksonville	Indianapolis	Shreveport 69	Wichita Falls, Texas
Atlanta	Louisville	Anniston, Alabama	Lafayette, La.

DOWELL

A SERVICE ORGANIZATION

HERE'S WHY

TILCO-FIN CUTS THE COST OF HEAT TRANSFER AS NO OTHER FIN TUBING CAN!

EXCLUSIVE!
- *segmented fins*
- *fused metal shoulder*

MOVE TWICE AS MUCH HEAT*
per unit of surface as any other type of fin tubing!

See how much TILCO-FIN will save in your plant

SURE, fin tubing is the best way to handle most heat transfer operations. Cost data from dozens of industries prove it—over and over again.

The important thing is to get the *best* fin tubing.

Cost data and independent testing provide a positive answer here, too—TILCO-FIN!

Millions of feet of this cost-cutting tubing are in use today, *setting economy records* for waste heat steam generators, air-cooled jacket water exchanges, air-cooled condensers, air-cooled lube oil coolers, gas heaters and coolers, instrument enclosure heaters, blast coils for space heating and cooling.

You can get all of Tilco tubing's exclusive advantages on large jobs or small, a tailor-made installation that will *transfer twice as much heat per unit of surface!* The fused shoulder eliminates costly heat loss due to interfaces of dirt, air and corrosion common on other types of tubing. It's a rugged, welded fin bond that *will not break!*

Chemical and Power Engineers Valuable New Handbook FREE!

Get all the facts about this modern way to multiply your savings on heat transfer jobs. This newest fin tubing reference source puts everything you need to know about extended surface equipment right at your fingertips in accurate easy-to-use form. Just clip the coupon below to your letterhead and mail today!

12 page, file-size booklet. Tells you how to choose and use fin tubing to best advantage. Includes data tables, graphs, charts, nomograms.

*Proved in independent comparison tests by Norris and Spofford, Transactions of the ASME, July 1942

TILCO-FIN DIVISION, Kentile, Inc.
58 2nd Ave., Brooklyn 15, N. Y.

Please send me, without charge or obligation, a copy of the Tilco-Fin Tubing Handbook.

Name_____

Firm_____

Street_____

City_____ Zone_____ State_____

More EQUIPMENT NEWS

Begins on page 162

Power supply includes input and output fuses, power on-off switch, H.V. on-off switch, H.V. control on the front panel. High voltage dc terminals are clearly marked on the front panel. Either positive or negative terminals of high voltage supply may be grounded.

Kepco Laboratories, Inc, 149-14 41st Ave, Flushing, N. Y.

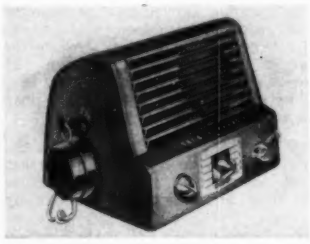
For more data on these items, use post cards, p171. Identify request with P and number.

MASTER SWITCH **P1260**

For heavy-duty installations, dustproof switch features new cast-aluminum cover and up to five adjustable stops. For large materials-handling equipment like steel-mill type cranes. Aluminum cover protects switch interior from dust, dirt, and accidental blows.

Adjustable stops provide for one to five points of movement of operating handle in either clockwise or counterclockwise direction. Open end wrench is the only tool required to make this adjustment.

General Electric Co, Schenectady 5, N. Y.



INTERCOM PHONES **P1262**

Incoming calls may be answered forty feet from any master station or sub-station. Master stations may talk with each other, sub-stations may be called selectively, or exclusively to any master station, and any master may be used privately or non-privately at its own option.

Talk-A-Phone CL series is designed for systems requiring more than one master station along with sub-stations. Incoming calls may be answered by master stations or sub-stations without manual operation.

prevents wear on seats of

CHAPMAN

Tilting-Disc

CHECK VALVES

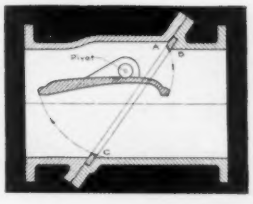
Here's the check valve with the balanced disc which is cushioned to a quick and quiet closure by the flow of gases or fluids as you can see in the cross-section at the right.

This smooth action prevents undue wear on seats, hinge pins and bearings . . . *and on your maintenance budget!* For there's no loosening of lines by vibration, no opened joints or ruptured pipes.

What's more, head losses are 65% to 80% less than conventional swing-type checks. Available in iron or steel in all standard pipe sizes. Get the complete story on this and other cost-cutting features of Chapman Tilting-Disc Check Valves, in the latest bulletin, No. 30. Send for your copy now.

THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting-Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

For easier installation — Lower maintenance

TYPE B DESIGN FEATURES

- Factory fabricated boilers require minimum field work.
- In many cases, sizes up to 25,000 lbs. per hour can be shipped completely assembled.
- Water tubes along furnace side walls reduce maintenance costs.
- Furnace design provides high efficiency with any method of firing.
- Extremely low head room. Maximum capacity for floor area.
- Can be operated at high overloads without disturbing water level.

Write for free catalog on the Type B or on any of the units listed below.

Boilers By Bigelow

Water Tube Boilers — Bent Tube Types • Horizontal Return Tubular Boilers • Scotch Type Boilers • Two-Pass Boilers • Electric Steam Generators

This Type B — Boiler By Bigelow being installed was shipped completely assembled. It has a capacity of 20,000 lbs. steam per hr. continuous, 25,000 lbs. steam per hr. peak loads. The boiler is 10'7" wide, 21'9" long, 15'10" high and has 3,287 square feet of heating surface.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

BIGELOW REPRESENTATIVES: Boston • New York • Philadelphia • Syracuse • Detroit • Chicago • Atlanta • Milwaukee New Orleans • Oklahoma City • Petersburg, Va. • Washington, D.C. • Albuquerque • San Francisco • Seattle • Sumter, S. C.

B1-7

More EQUIPMENT NEWS

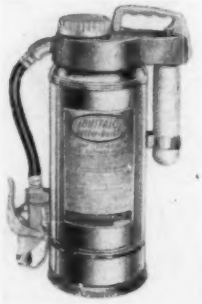
Begins on page 162

at a considerable distance from the unit.

CL-5 is combination system for five-station use, and the CL-10 is combination system for ten stations. Master stations are equipped with talk-listen switches, standby, station selectors and volume control, while staff stations require no manual operation.

Talk-A-Phone Co, 1512 S Pulaski Rd, Chicago, Ill.

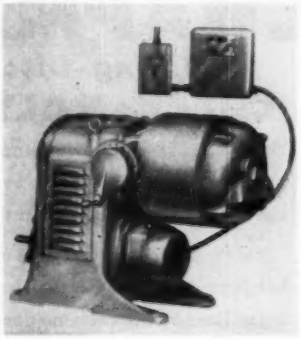
For more data on these items, use post cards, p171. Identify request with P and number.



FIRE EXTINGUISHER P1222

Stainless steel, lightweight, dry-chemical fire-extinguishers of 20- and 30-lb capacity, have finger tip control, shoot a chemical heat-insulating cloud up to 20 ft. Snuffs out flames on contact.

Buffalo Fire Appliance Corp, Dayton, Ohio



MOTOR-BRAKE P1242

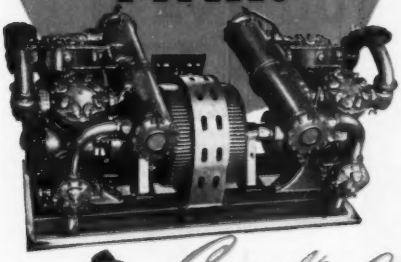
Fast, controlled braking of U.S. *Varidrive* motors through type ICB brake mounted directly on variable speed shaft. Suited for inching or jogging, the ICB offers instant, shockless operation without noise and produces a constantly increasing torque during stopping.

Unlike the solenoid type brake, its frictional force is controlled directly by magnetic action. Braking torque, once set, is

Get TROUBLE-FREE AIR POWER at ROCK-BOTTOM COST!

JOY Series 100 compressors are available in two and four cylinder models and in single and twin units. Capacities from 378 to 3656 c.f.m.

UP TO 3656 C. F. M. in a TWIN!



with a JOY PACKAGE TYPE

HEAVY DUTY WN-114 COMPRESSOR

Install it, start it,—then forget it! That's what you can do with a JOY compressed-air power unit, because it's built to give constant, dependable service 24 hours a day, year in and year out. JOY Series 100 Air Compressors are two-stage, double-acting, heavy duty, continuous service compressors—much smaller than old style compressors of the same capacity, yet with operating economies exceeding those of the older, bulkier units. JOY *pioneered* the compact, modern, "package-type" compressor.

All wearing parts are replaceable on the Series 100—the finest air compressors you can put on the job. ● *Let us give you full details on the size that fits your air-power requirements.*

Consult a Joy Engineer

100 Years of Engineering Leadership

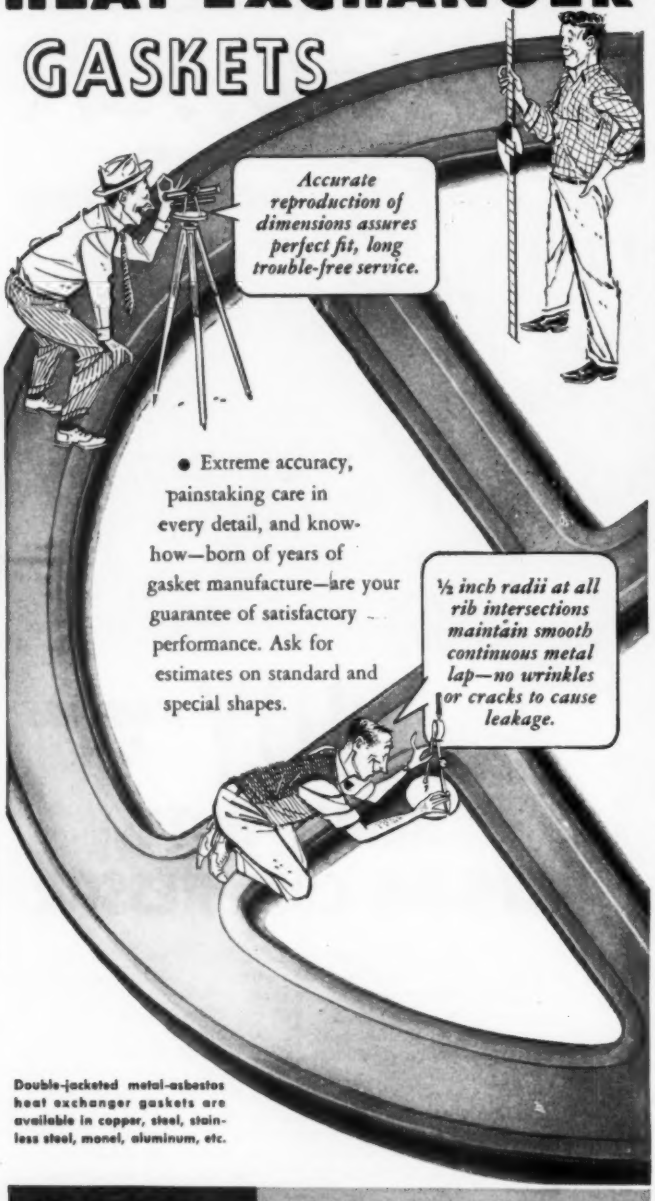
W&D I 3513

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

HEAT EXCHANGER GASKETS


Accurate reproduction of dimensions assures perfect fit, long trouble-free service.
• Extreme accuracy, painstaking care in every detail, and know-how—born of years of gasket manufacture—are your guarantee of satisfactory performance. Ask for estimates on standard and special shapes.
½ inch radii at all rib intersections maintain smooth continuous metal lap—no wrinkles or cracks to cause leakage.

Double-jacketed metal-asbestos heat exchanger gaskets are available in copper, steel, stainless steel, monel, aluminum, etc.

UNITED STATES GASKET COMPANY

680 N. 10TH STREET, CAMDEN, N.J.

LEADING FABRICATORS OF "TEFLON" FOR THE CHEMICAL, PROCESS AND ELECTRONIC INDUSTRIES

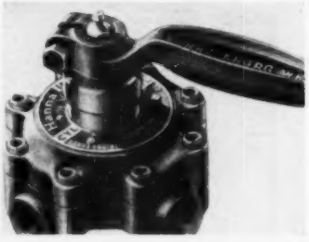
More EQUIPMENT NEWS

Begins on page 162

permanent—an important aid in applications demanding accurate regulation. The small, compact brake is dc actuated with low power requirements—maximum 25-35 watts. Power conversion units are used where ac voltage is supplied.

U.S. Electrical Motors, Inc, 200 E Slauson Ave, Los Angeles 54, Calif.

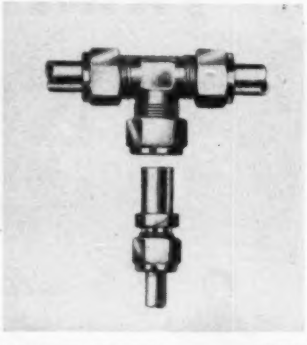
For more data on these items, use post cards, p171. Identify request with P and number.



HAND-OPERATED VALVES P1205

Unitite valves for 3- or 4-way operation up to 250 psi in 3/8, 1/2 and 3/4 in. sizes, to 150 psi for 1 in., and to 100 psi for the 1-1/4 in. size, have long life. Design features include chrome-plated stem for minimum wear, neoprene stem collar to prevent abrasion from dust, standard grease-fitting at stem top, and a lumen bronze disk. Valve handle movement is limited by internal stops to allow a 360-deg option of handle placement for operator's convenience.

Hanna Engineering Works, 1765 Elston Ave, Chicago 22, Ill.



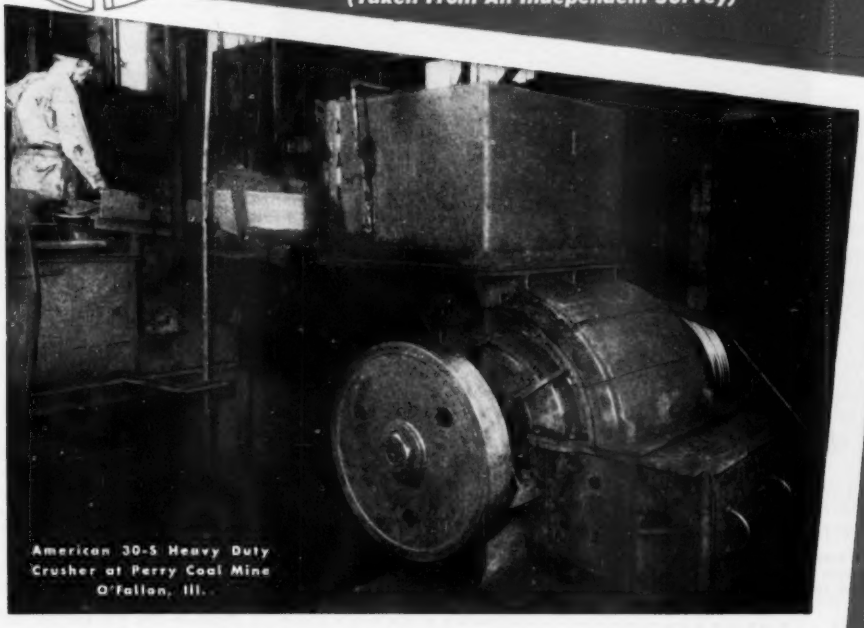
REDUCER FITTING P1206

Swagelok reducer fitting permits different sizes of tubing to be easily joined. It consists of a body, two ferrules and a nut. Ferrules and a threaded chuck inside clinch tightly around tubing wall for a leakproof seal. In brass, aluminum, steel, stainless steel and monel with sizes ranging from 1/8 to 7/8 in. OD. Holds heavy- or thin-wall tubing, and no preparation of

CASE HISTORY No. 12

"CRUSHING" FACTS on *American Crusher* PERFORMANCE

(Taken From An Independent Survey)



American 30-S Heavy Duty Crusher at Perry Coal Mine O'Fallon, Ill.

HEAVY DUTY *American* CRUSHER CUTS COSTS 66%!

PRIOR to the installation of this heavy-duty American Rolling Ring Crusher at the Perry Coal Mine in O'Fallon, Illinois, three men were stationed at the picking table—removing rock, slate, sulphur balls and foreign material that were either too large or too hard to reduce in the single roll crusher then in use.

Since the American installation, only *one* man is needed . . . this heavy-duty machine is tough enough to handle any size ROM coal hoisted, as well as rock or impurities. Installed May, 1950, this American Crusher shows *no sign of wear*—even though all plus 7" coal and refuse from a 1,000,000-tons-a-year mine passes through it.

Write for coal crushing Bulletin

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Ave., St. Louis 10, Mo.

Clean them the LAGONDA way—

...BIG TUBES ...small tubes
STRAIGHT TUBES
...or curved!

LAGONDA gives you the *right* cleaner for any tube cleaning job in your plant—all the way from ½ in. tubes up to 20 in. I.D. pipes. Utilize the 50 years of tube cleaning experience back of LAGONDA—the oldest name in tube cleaning. Write today for the LAGONDA Bulletin.

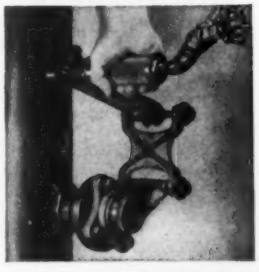
SUSPENSION CLEANERS
For small straight tubes. Motor remains outside of tube. Air, steam, or electric drive.

600 SERIES —For small tubes, straight or curved. For a fine cleaning job on tubes ½ to 1½ inches.

1300 SERIES—Air-driven cleaner for boiler tubes, straight or curved.

SURE CURE FOR LEAKY HANDHOLE SEATS!

When replacing handhole covers, prevent costly leaks by regrinding the seat with a LAGONDA Handhole Seat Grinder. Grinder clamps to header with a positive action that insures an accurate, single-plane motion of abrasive wheel. Steam cuts and pittings are easily and economically ground out. The cover mates with seat for an absolute leakproof fit. Write for the Handhole Seat Grinder Bulletin.



HALF CENTURY OF 1901 E 1951 POWER PROGRESS

Y-305

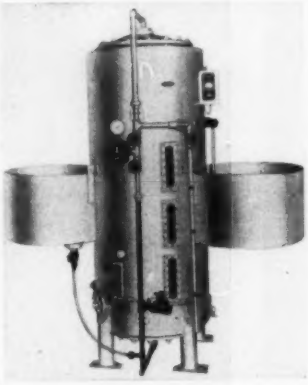
ELLIOTT Company
LAGONDA DIVISION • SPRINGFIELD, OHIO
Plants at: Jeannette, Pa. • Ridgway, Pa. • Ampere, N. J.
Springfield, O. • Newark, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

More EQUIPMENT NEWS

Begins on page 162

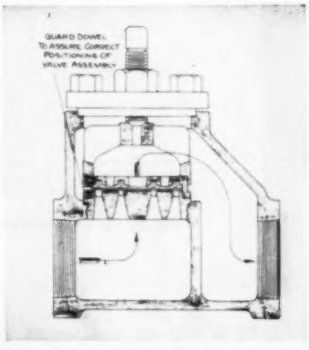
tubing is needed before making up the seal. Fitting made for use with brass, aluminum, steel, stainless steel, monel and plastic tubing.
Crawford Fitting Co, 884 E 140th St, Cleveland 10, Ohio

For more data on these items, use post cards, p171. Identify request with P and number.



MONO BED DEMINERALIZER P1221

Cation and exceptionally strong base anion exchangers are mixed in a single unit tank. Raw water passes through this *Mono-Bed* column only once yet comes out with mineral content practically zero (resistances are reported as high as 20,000,000 ohms per centimeter). Available in flow rates from a few to 5000 gph.
Penfield Mfg Co, Inc, 19 High School Ave, Meriden, Conn.



AUTOMATIC AIR-CHECK VALVE P1203

PPC Aircheck valve dispenses with usual stop, safety and globe valves, prevents pressure leakage through compressor during OFF cycle, dampens pipeline pulsations, and permits repairs without

we'll do the job with 3 sq. ft.

OF HEATING SURFACE PER B.H.P.

and we can prove it!

with CYCLONIC COMBUSTION

WE REPEAT! Through the principle of *patented* CYCLONIC COMBUSTION, **CYCLOTHERM** packaged steam generators will produce maximum heat transfer on *any* job . . . *any* application . . . with only 3 square feet of heating surface per B.H.P. That is not an advertising claim - we are stating a fact— *backed by our unconditional guarantee!*

This remarkable performance is based on a revolutionary advance in the principles of heat transfer. In the Cyclotherm unit, the air enters the combustion chamber at a high velocity, and mixing with the fuel is made to *spiral in a revolving vortex* along the entire length of the furnace. This controlled spiral is actually cyclonic in motion. This intensely luminous flame transfers heat to the fire tube both by radiation and convection, resulting in an unusually high rate of heat transfer. *There are no hot spots!* The efficiency of the Cyclotherm principle plus the ingenuity of Cyclotherm design calls for 3 square feet of heating surface per B.H.P. required—*and no more!*

The Cyclotherm meets all state requirements and is built in accordance with A.S.M.E. and National Board Standards and bears the label of UNDERWRITERS LABORATORIES, INC.

Full power operation from a cold start in 15 to 20 minutes. Savings up to 50% on maintenance. Great fuel operational savings.

Boilers are designed for oil or gas operations from 18 thru 500 h.p., 15 to 200 lbs. operating pressure.

Details of these and many other facts regarding Cyclotherm generators are available by writing Dept. M.

DISTRIBUTORS

Air Conditioning Engineers, Inc.
Mobile, Alabama
Wm. Barrington & Son, Inc.
Cleveland 3, Ohio
Wm. Barrington & Son, Inc.
Phoenix, Arizona
The Bingham & Bisdon Company
Green Bay, Wisconsin
Carl A. Bovard
Lake Placid, New York
R. J. Clark Equipment Co.
Clearwater, Florida
Crawford Power Equipment Company
Cincinnati, Ohio
Delavan Engineering Company
Des Moines, Iowa
Davenport, Iowa
Dempster Brothers, Inc.
Knoxville 17, Tennessee
Flagg, Brackett & Durgin, Inc.
Boston, Mass.
General Automatic Corporation
Baltimore, Maryland
General Industrial Supply Corp.
Fort Worth 1, Texas
Mr. J. Clifford Hannah, Jr.
Pittsburgh, Pa.
Howell Engineers
Houston, Texas
Hungerford, Inc.
Richmond, Virginia
The Iron Fireman Sales Corp.
Washington, D. C.
Royster H. Johnson Company
Charlotte 1, North Carolina
Kisco Boiler Engineering Company
St. Louis 10, Missouri
Mr. C. O. Bergland
San Francisco, Calif.
Phillips Engineering Company
Detroit, Michigan
Rumbold and Company Inc.
Atlanta 3, Ga.
John L. Shank Heating Equipment
Indianapolis, Indiana
The Shaw Kendall Engineering Company
Toledo 3, Ohio
Technical Service Company
Albuquerque, New Mexico
Temperature Equipment Corporation
Chicago 51, Illinois
P. Thompson Tool and Supply Company
New Orleans, Louisiana
David Thomson Associates, Inc.
Haverford, Pa.
Caleson Engineering Company
Portland, Oregon
Michal-Herman
Buffalo 13, N. Y.
Pittsburgh Water Heater Sales Co., Inc.
Los Angeles, Calif.

EXPORT

Drake American Corporation
New York, New York

MORE POWER per operating dollar

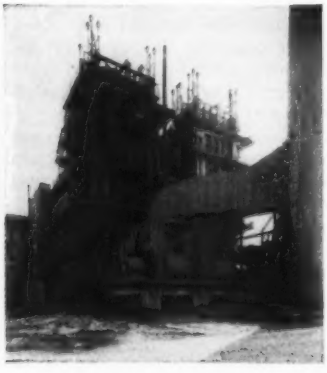
see our CATALOG in SWEET'S FILE

CYCLOTHERM
STEAM GENERATORS
OSWEGO, NEW YORK

GREEN FANS . . . Used by Many Leading Utilities

One significant fact about Green Fan Installations at the New Orleans Public Service Plant is that two different boiler manufacturers were involved . . . two different types of boilers but Green Draft Fans for all three boilers. Each boiler has two Green Induced Draft Fans and one Green Forced Draft Fan.

When a concern has specialized on an important piece of power plant equipment for many years, that firm is rightly called the "authority" on the subject. This is the position of Green Fuel Economizer Co. in the field of mechanical draft fans. The name Green is synonymous with Draft Fans highly acceptable to industry.



The Line of Green Induced and Forced Draft Fans includes many types in many sizes which are described in Bulletin No. 168. We shall be glad to discuss your fan requirements with your own engineers, with your consulting engineers and with the boiler manufacturer of your choice.

THE GREEN *Fuel Economizer* COMPANY INC.

BEACON 3, NEW YORK

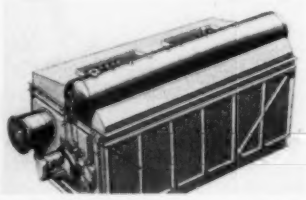
ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

More EQUIPMENT NEWS

Begins on page 162

shutting down system where more than one compressor is on the line. Entire unit is self-contained and automatic. Disks and springs are stainless steel; there are no screws or bolts to burn out quickly, nor can parts jar loose and damage cylinder. **Pennsylvania Pump and Compressor Co, Easton, Pa.**

For more data on these items, use post cards, p171. Identify request with P and number.

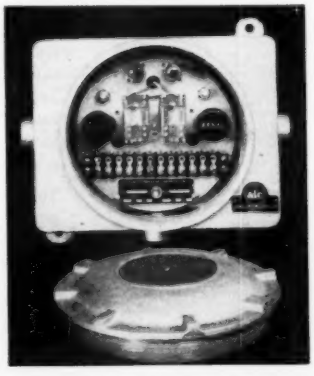


PACKAGED BOILERS P1232

Two new packaged water-tube boilers are self-contained and ready to install. Can be mounted wherever load capacity of base is adequate. They fire either gas or oil. Capacities at 160 psi, model W-1, 4100 to 11,600 lb per hr, W-2, 11,400 to 23,500.

Among advantages are easy handling, low maintenance costs, speedy circulation of water and hence fast steaming.

Wm Bros Boiler & Mfg Co, Minneapolis 14, Minn.



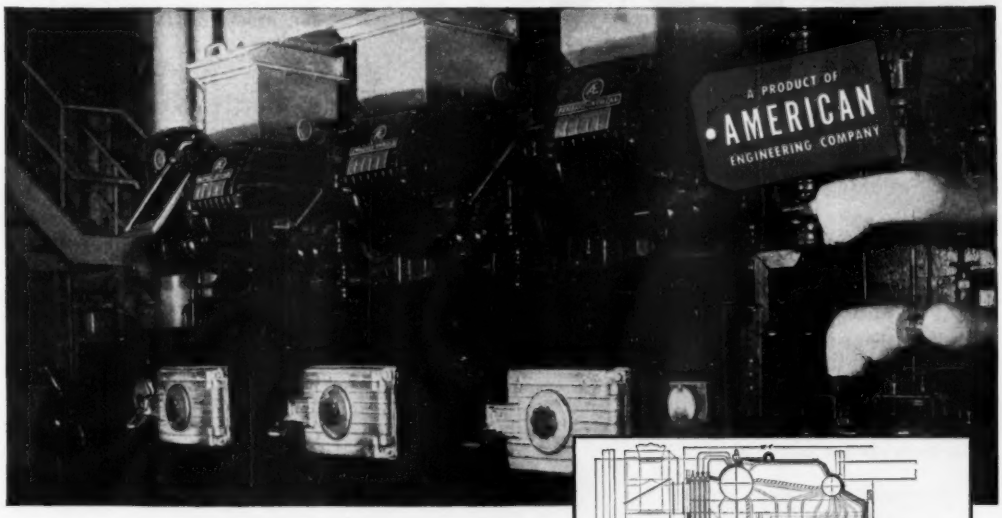
PRESSURE TRANSMITTER P1244

Explosion-proof diaphragm differential-pressure transmitter for determining level of catalyst in storage tanks, transfer bins and withdrawal drums. Installed in a hydrocarbon pilot plant, this linear transducer measuring system provides a remote visual signal instantaneously.

Four of these transmitters, with a range of 0-600 psi max static pressure, and designed to trip the indicating relay with as little as 1 in. of water differential pressure change, are installed at various levels in

Merck & Co. Inc., get 85% boiler efficiency with

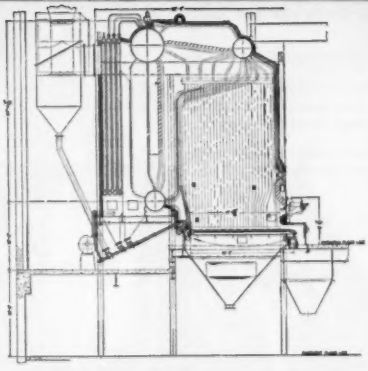
PERFECT SPREAD STOKER



TEST RUN of a recent Merck installation shows an actual boiler efficiency of 85% operating at average load of 71,500 lbs. per hour. The combination of a modern boiler and a Perfect Spread Stoker permits the use of economical high ash coals and assures big annual savings in fuel costs.

Perfect Spread Stoker burns high and low ash coals with equal facility. Its unique feeder provides positive, continuous coal feed and even distribution. *It never clogs on wet coal.* Its fly ash reinjection and adjustable overfire air system brings maximum fuel economy. And Perfect Spread has a capacity range from 8,000 to 500,000 lbs. of steam per hour. With individual capacities from 50 lbs. to 7500 lbs. of coal per hour, the chain conveyor feeder eliminates puffs of smoke common to slug stoking.

Send for booklet fully describing the Perfect Spread Stoker. And if you are considering boilers in capacities from 300,000 to 500,000 lbs. of steam per hour, call us in to discuss cross-firing.



Edge Moor 3-drum boiler fired by 3-feeder Perfect Spread Stoker-with traveling grate. Design engineers, Smith, Hinchman & Grylls, Inc.

WON'T CLOG ON WET COAL

AE

AMERICAN ENGINEERING

COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2400 Aramingo Avenue, Philadelphia 25, Pa.

Gentlemen: Kindly send me free copy of Perfect Spread Stoker booklet ( ). I should like to discuss cross-firing ( ).

Name.....Title.....

Company.....

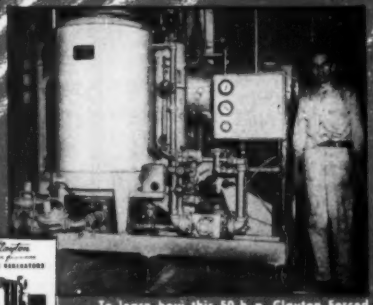
Address.....

City.....Zone.....State.....

PROCESSING
STEAM
at LOWER COST

BECAUSE:

- fuel savings of from 20% to 50%
- full operating pressure in 5 minutes from a cold start
- instant recovery to meet any peak demand within rated capacity
- simple, safe and foolproof control of feedwater and fuel
- no expensive standby losses
- low installation cost—no boiler or pump to install, no fire brick, stack or accessories
- less space and weight per horsepower



To learn how this 50 h. p. Clayton Forced Recirculation Steam Generator reduced steam production costs by 70%...MAIL THE COUPON

MAIL THIS COUPON TODAY

Send name of nearest distributor and arrange desk demonstration of Clayton Forced Recirculation principle. Send catalog. P-12

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

Animated flow chart shows how Forced Recirculation principle cuts steam costs.

Clayton MANUFACTURING COMPANY
BOX 550, EL MONTE, CALIFORNIA

More EQUIPMENT NEWS

Begins on page 162

the tank and electrically connected to a thyratron relay. An indicator light panel some distance away is connected to the relay. Inert gas supply line connects to the pressure transmitters. Gas supply is maintained at pressure slightly higher than that of tank.

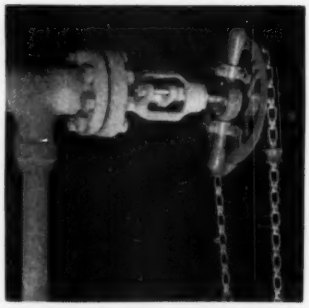
Automatic Temperature Control Co, Inc, 5200 Pulaski Ave, Philadelphia 44, Pa

For more data on these items, use post cards, p171. Identify request with P and number.

CONDENSATION RETURN UNITS P1204

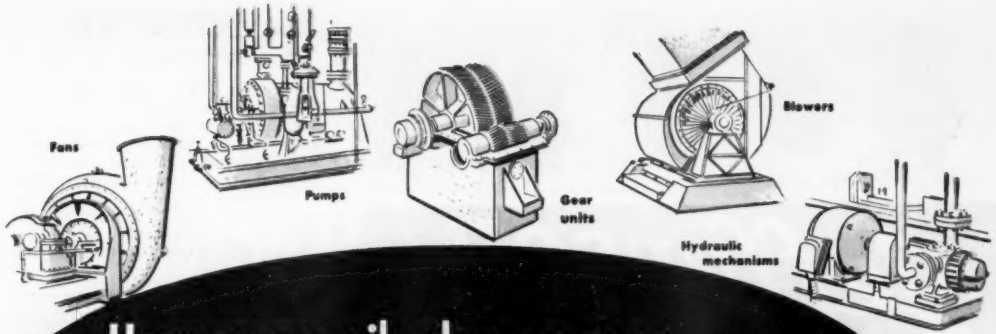
Motor-Mount unit returns to boiler condensate from steam coils, radiators and other steam-operated equipment. This is centrifugal pump with enclosed-type bronze impeller and stainless-steel shaft. Pump mounts on tank legs so no base is needed, and motor may be single- 2- or 3-phase, or dc, as specified. Both single and duplex units are available. Duplex serves excess loads and acts as standby pump. Single units include pump, motor, storage tank, suction piping, float switch and water-level gage; duplex units have two pumps and motors. Capacities from 2000 to 40,000 sq ft EDR.

The Deming Co, Salem, Ohio



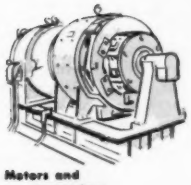
HANDLE FOR SMALL VALVES P1201

Impactor handle makes it easy to close small valves 10 to 50 ft above floor. It delivers 2.8 times the force of usual handwheels. Lugs on handle underside strike



How many oils do you use for auxiliary plant equipment?

You need only GULF HARMONY OIL



—Outstanding many-purpose oil for equipment like this!

You can lubricate all your plant auxiliary equipment better with just this one oil—Gulf Harmony Oil. It's equally effective for sleeve-type and antifriction bearings, hydraulic mechanisms, compressor cylinders, and many types of gears.

Here are a few of the many reasons why Gulf Harmony Oil performs so well in so many different applications. First, it has high resistance to oxidation and the formation of sludge. In oil circulating systems, reservoirs, hydraulic systems, and antifriction bearing pedestals, this means freedom from harmful deposits and insures against premature oil changes.

Then the lubricating film provided by Gulf Harmony Oil has preferential wetting characteristics for metal—it displaces moisture, interrupts its corrosive action. That's how this quality oil prevents rust on all oil-bathed surfaces—a particularly important function in precision hydraulic valves and in antifriction bearings operating under damp conditions.

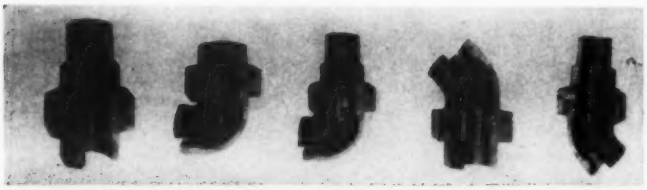
And because it has good water-separating characteristics, there is less chance of emulsification and the useful life of each fill is prolonged.

Gulf Harmony Oil is available in a wide range of viscosities and is inhibited to provide more effective protection against wear under boundary conditions.

For further information on Gulf Harmony Oil and for expert help on your lubrication problems, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office.

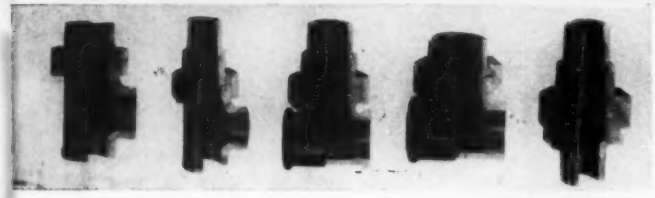
Gulf Oil Corporation · Gulf Refining Company,
Gulf Building, Pittsburgh 30, Pa.

FIFTY YEARS OF SERVICE
1901 GULF 1951
PETROLEUM AND ITS PRODUCTS

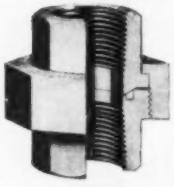


Jefferson

AIR-REFINED, AIR-TESTED
MALLEABLE IRON
UNIONS
... featuring the RECESSED BRASS SEAT



Universally accepted wherever piping is used . . .



The exclusive "Recessed Brass Seat" characterizing Jefferson Unions has won universal good will in piping installations everywhere.

This seat—common to "Jeffersons" in all types and sizes—assures permanent tightness with least effort in making up joints. Located in a machined recess of the fitting, it is protected against pipe ends screwed in too far and imposes no restriction to flow through the fitting. A brass ring, *machined* from tubing is press fit into *machined* recess to form a seat that is always tight and dependably secured against rocking. Hence the permanently tight joints which "Jeffersons" invariably assure.

Jefferson can also supply 300 ≠AAR, Enduro 300≠, Excel 250≠, Master 150≠ and a full line of all-iron ground seat unions.

Ask your nearest distributor to supply your needs—or get in touch direct with us.

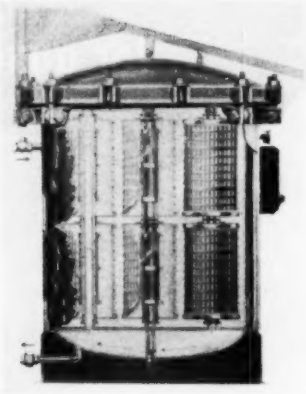
Jefferson UNION CO.
605 W. 26th St., New York 1, N. Y.
63 Gooding St., Lockport, N. Y.
39 Fletcher Ave., Lexington 73, Mass.

More EQUIPMENT NEWS

Begins on page 162

simultaneous blows against lugs of an adapter securely attached to valve stem. There is no stem twist or distortion. Available with two adapters of different-size square openings to fit most standard-size stems of various small-valve makes. Sizes of the square openings, which taper toward the top, are 13/16 and 15/16 in. with total taper equal to 3/4 in. per ft.
Edward Valves, Inc., East Chicago, Ind.

For more data on these items, use post cards, p171. Identify request with P and number.

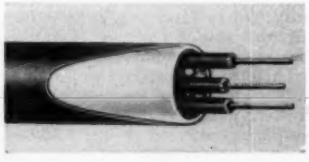


OIL FILTER **P1250**

Improved units include swingbolt head construction for quick opening of filter covers and a lifting device for ease of handling the cover. Filters are available using factory-made throw-away cartridges or repackable type that operator repacks from bulk supply.

Filtering materials for these units handle straight-run mineral oils, or the heavy-duty detergent type oils. All type filter cartridges, both factory-made and the repackable type, are interchangeable.

Hilco filters are available in capacities ranging from ½ gpm up to 1000 gpm, for fuel oil filtering, lubricating oil bypass, or full-flow filtering.
Hilliard Corp, 159 W Fourth St, Elmira, N. Y.



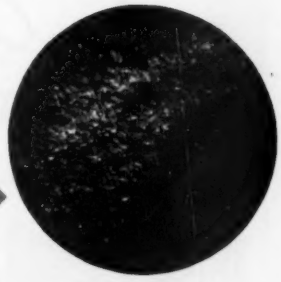
ELECTRICAL TUBING **P1259**

Plastic-armored electrical metallic tubing for use where corrosive atmospheres necessitate frequent replacement of electrical conduit. A .020-in. coating of tough, cor-

Will Corrosion, Carryover or Tube Failure Tie-Up Your Boilers This Month?

Whether you operate high or low pressure boilers . . . corrosion, carryover and tube failures are mighty expensive . . . not only in tube replacement and installation costs, but in loss of valuable production time.

These photomicrographs show how proper treatment can reduce tube failures.



On this tube from a high pressure boiler, iron oxide particles have deposited as magnetic iron oxide "scale." Even when distilled make-up is used, this type of deposit frequently occurs, causing tube failure. Although the conventional alkali-phosphate-organic treatment was used, it did not prevent deposits from adhering.

This is a tube operating under similar conditions except that the boiler water has been treated with Drew Complete Boiler Water Treatment. This treatment chemically alters iron oxides—and other types of deposit formations. It makes them non-adherent and eliminates costly tube failure.

Send for new DREW ORGANICS *folder describing the use of organics in modern boiler water treatment. Write today.*

Whether you operate high or low pressure boilers . . . whether your tube failures are caused by iron oxides or any other type of deposit . . . you'll find that Drew can provide a practical, economical solution to your water conditioning problems. Thoroughness of investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies.

POWER DREW CHEMICALS

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

DREW PRODUCTS

Nationwide Service in Boiler Water and Cooling Water Conditioning

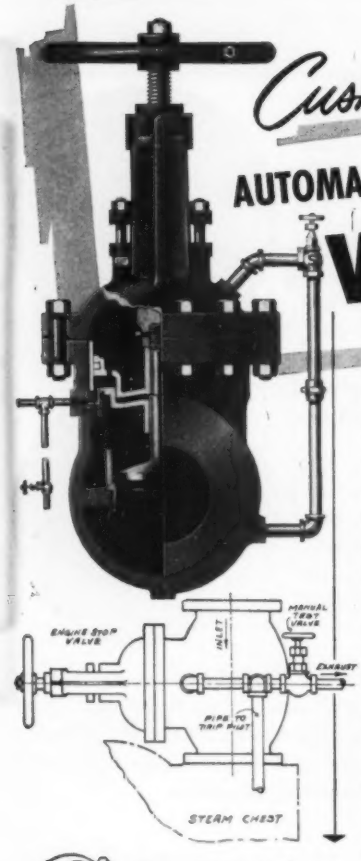
WHEN ENGINES, TURBINES OR COMPRESSORS *OVERSPEED*

Shutdown is Automatic

with GA

Cushioned

AUTOMATIC ENGINE STOP VALVES



Mechanically or Electrically Tripped

A single speed governor trips a pilot control valve, which automatically closes this valve against inflow pressure—thus assuring complete protection from damage caused by overspeeding.

All Golden-Anderson Valves have a special double cushioning feature which prevents banging and chatter.

Get the life and property protection you need—specify and install Golden-Anderson cushioned engine stop valves today!

Do you have Bulletin S-3 which describes this valve in detail?

GOLDEN ANDERSON *Valve Specialty Company*

2070 KEENAN BUILDING • PITTSBURGH 22, PA.

More EQUIPMENT NEWS

Begins on page 162

rosion-resistant vinyl or polyethylene plastic is extruded over standard galvanized electrical metallic tubing. By varying thickness and composition of plastic armor, conduit can be given any desired dielectric properties.

Dekoron conduit is impervious to corrosive effects of moisture, salt air, acids, alkalies, oils and grease, and is immune to normal temperature changes.

Installation of *Dekoron* conduit is easy: no special tools. Standard compression-type couplings and connectors wrapped with electrical insulating tape are used at joints.

Samuel Moore & Company, Mantua, Ohio

For more data on these items, use post cards, p171. Identify request with P and number.

HIGH-PRESSURE TRIPLEX PUMP P1202

Heavy-duty, packaged hydraulic power generator is for all types of hydraulic-power systems. It comes in 15, 30 and 50 hp sizes with pressure ratings to 5000 psi and displacements to 60 gpm. Special 10,000- and 20,000-psi heads are also available. Interchangeable plungers and liners provide variety of pressure-volume ratings for each unit. Spring-loaded balls and hardened and ground seats serve as inlet and outlet valves. Built-in features include pressure lubrication, pressure gage, relief valve and scavenger pump. Unit is completely enclosed.

Kobe Inc, Div of Dresser Equipment Co, Huntington Park, Calif.

UPPER CYLINDER OIL P1241

Suitable for upper cylinder lubrication of gasoline and LP gas engines, *Universal top oil* has high solvency power. It dissolves sludges, resins, gums and varnishes which form in engine upper cylinders. Inhibitors help prevent formation of rust and oxidation products and neutralize acid formations that are normally present in gasoline engines.

Possesses high film strength, as well as

Piping installations, both large and small, are our daily business and have been for more than fifty years. During that time we've handled all kinds of tough jobs, and today "Piping by Mitchell" means *quality* to power and process engineers everywhere. If your next project involves high-temperature, high-pressure, or corrosion problems, send us your drawings for an estimate.

This frog will fit YOUR POND!

We are independent piping fabricators and erectors.

W. K. MITCHELL & CO., INC.

2944 Ellsworth Street, PHILADELPHIA 46, PA.

Representatives in Boston, New York, Cleveland, Mobile, and Havana

WESTPORT JOINT
(PATENTED)

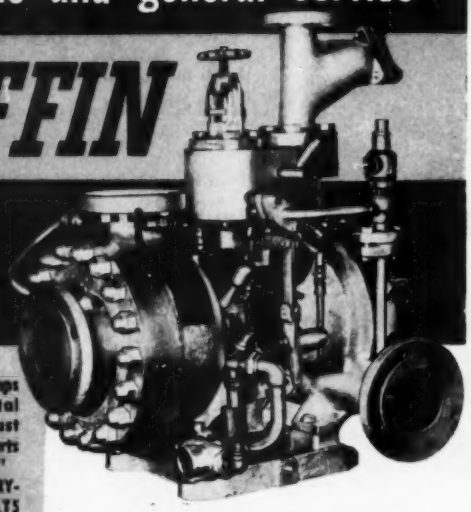
MITCHELL

PIPING FABRICATORS AND CONTRACTORS SINCE 1899

Solve tough pumping problems in marine and general service

with **COFFIN**

TURBO PUMPS



Installing COFFIN Pumps Gives You These Vital Advantages plus Fast Service on Wearing Parts —ALSO "SAME DAY" SHIPMENTS OF FACTORY-GUARANTEED REBUILTS

- Steam Pressures to 850 PSI
- Back Pressures to 200 PSI
- Pump Capacities to 500 GPM
- Discharge Pressures to 1100 PSI
- Matched Pump, Turbine and Governors in One Lightweight Compact Assembly
- Efficient Pump and High Speed Two-Bucket Row Turbine Minimizes Steam Consumption
- Interstage Leakage Is Eliminated
- All Parts Made to Gauge and are Replaceable Without Fitting

SPECIFIED FOR MINIMUM STEAM CONSUMPTION AND LONG, TROUBLE-FREE OPERATION—

Superior Coffin engineering provides 3 to 12 stage performance from compact 1-stage turbo pumps composed of standarized, easily replaced stock parts. The high efficiency Coffin Pumps combined with high speed, two-bucket row turbines conserve on steam at shaft speeds as high as 7200 RPM. Compact, with extremely quiet, vibrationless operation, Coffin Turbo Pumps reduce lost time due to pump failures by providing smooth, dependable performance over long periods of continuous service. For fast service on wearing parts or immediate shipment of a guaranteed rebuilt, call Coffin or your nearest Coffin representative.

AVAILABLE NOW! Write for your copy—

Complete data on Turbo Pumps for every marine and industrial application. Ask for your copy of the new Coffin File Folder, today!

COFFIN

THE J.S.COFFIN, Jr. COMPANY

324 SOUTH DEAN STREET
ENGLEWOOD, NEW JERSEY

REPRESENTATIVES IN ALL PRINCIPAL CITIES

More EQUIPMENT NEWS

Begins on page 162

oiliness and penetrating properties. This helps prevent formation of oxidation products, retards cylinder wall scuffing, and permits proper valve seating at high engine speeds.

Universal Lubricating Systems, Inc, Allegheny Ave, Oakmont, Pa.

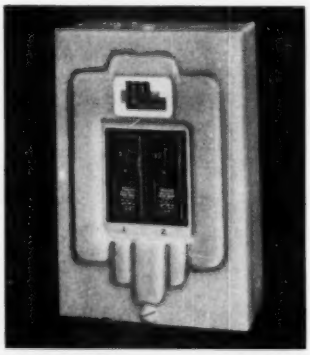
For more data on these items, use post cards, p171. Identify request with P and number.

METALLIZING GUNS **P1215**

Patented jet siphon in gas head of two new 4¾ lb metallizing spray guns automatically compensates for gas-pressure variations as high as 10 lbs and gives steady, unvarying flame to produce uniform coating at low cost. One model, *Metco* Type 4E, has been developed for machine element work and the second, Type 5E, serves for corrosion protection coatings.

Type 4E sprays all wires from 20 B&S gage to ⅛-in. dia in any metal 40% faster than do previous models. Type 5E is first gun specifically designed for high speed spraying of softer metals like zinc and aluminum.

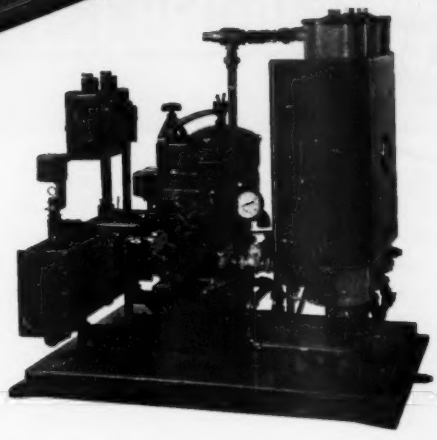
Metallizing Engineering Co, Inc, 38-14 30th St, Long Island City 1, N. Y.



LOAD CENTER **P1245**

Two-circuit load center will continuously carry 100% of full rated load. It has a rated 55-amp main with a capacity of two 50 amp, single pole, 120-v ac magnetic circuit-breakers. Fully-magnetic action dif-

"PURI-FILTERED" OIL [illegible] CLEAN
YOU CAN R[illegible] THROUGH IT!



Diesel lubricating oil that has been cleaned by a De Laval "Puri-Filter" is so clean that you can read a book through a test tube full. The oil is ***visibly*** clean — no dirt . . . no water . . . no colloidal carbon!

The "Puri-Filter" cleans oil two ways: (1) by centrifugal force, (2) by micronic filtration. First the De Laval centrifuge removes solid impurities and water, storing the dirt in the bowl of the machine and continuously discharging the water to waste. Then the lubricant is further purified by means of the filters which remove the specks of carbon that are lighter than the oil itself. You ***know*** that the oil going back to the crank case is clean.

De Laval "Puri-Filters" are complete, ready-to-run units. They are available in various capacities.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL *Oil Purifiers*

FOR DIESEL LUBRICATING OIL

NOW, AS ALWAYS

PABCO PRECISION MOLDED

UNIFORMITY

85% MAGNESIA HEAT INSULATION

PABCO Precision Molded INSULATIONS

APPROVED ENGINEERING SERVICE UNIT

Modern engineering demands precise standards of heat insulation performance. Pabco *Precision Molded* 85% Magnesia combines the time-tested superiority of Magnesia with precision molding to give you a light weight insulation manufactured to very close tolerances.

Simpler and easier to apply! Easier to lift, cut and score. Simpler to imbed tie wires flush in the surface, too!

LIGHT WEIGHT

Pabco *Precision Molded* 85% Magnesia weighs just 11 lbs. per cubic foot. In addition to its light weight, it also brings many timely advantages, including easy application and greater rind strength.

CLOSE TOLERANCES

Pabco's plus tolerance is only ½ *lb. per cubic foot!* This means an amazing degree of control over such factors as Weight and Thermal conductivity. Other controlled factors include size, thickness and uniform fibre distribution.

Precision pipe fit! Both pipe coverings and blocks are molded to exact final size and thickness, not molded oversize and then "milled" to size.

THE DEPENDABLE STANDARD — "MODERNIZED"

quality

PABCO PRODUCTS INC.

INSULATION DIVISION

San Francisco 19 New York 16

Manufacturers of Heat Insulation Since 1920

PABCO ENGINEERING SERVICE UNITS IN ALL PRINCIPAL CITIES

More EQUIPMENT NEWS

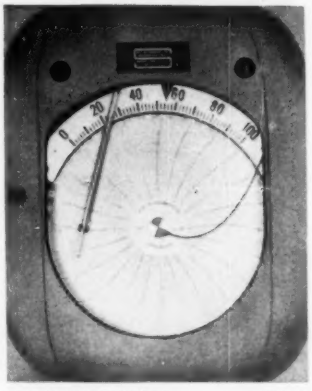
Begins on page 162

fers from all thermal devices—rated operation does not change with changes in temperature.

Load center can be used as a main disconnect in place of comparable 60-amp fused switch. It has specific application as a service entrance and main disconnect switch and for use on single phase lighting and appliance circuits.

Murray Mfg Corp, 1250 Atlantic Ave, Brooklyn 16, N. Y.

For more data on these items, use post cards, p171. Identify request with P and number.



SMOKE RECORDER P1226

Quick-acting, sensitive, null-balance potentiometer, the SR-66, is housed in rugged, steel case with molded bakelite door. The 12-in. chart for 24 hr recording set in the assembly makes record of smoke indication and can be applied on various instruments. Warning signals can be added.

Ess Instrument Co, 96 S Washington Ave, Bergenfield, N. J.

ALL-MAGNETIC REGULATOR P1249

Dc power supply voltage regulator uses no vacuum tubes; all-magnetic amplifier type circuit. Maintains power supply out-

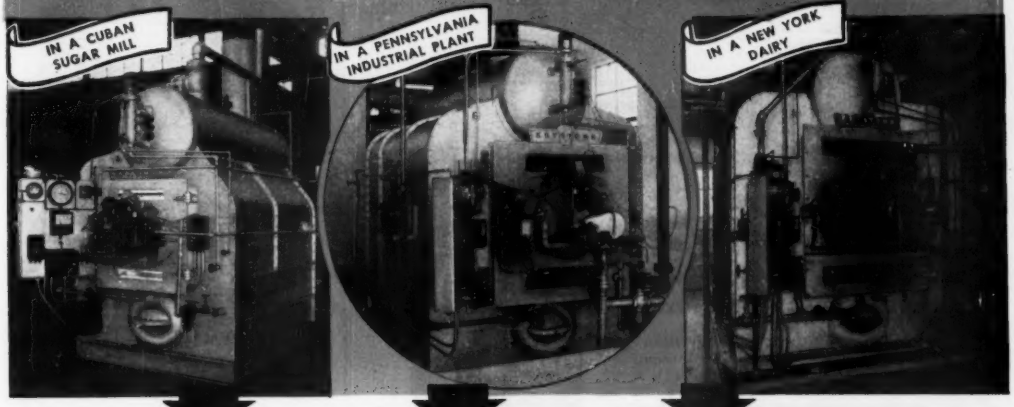
IMMEDIATE STEAM

Introducing the Newest Idea IN STEAM GENERATION!

ERIE CITY

KEYSTONE

STEAM GENERATOR



Developed Boiler Horse Power	75	100	150	200	250	300	350	400	450	500	600	700	800
Heating Surface Sq. Ft.	357	500	750	1000	1250	1500	1750	2000	2250	2500	3000	3500	4000
*Capacity Lb./Hr.	2490	3320	4980	6640	8290	9950	11,610	13,290	14,940	16,620	19,930	23,220	26,550
Overall Length — A	14'-10"	14'-10"	19'-6"	19'-6"	20'-0"	22'-0"	22'-0"	23'-0"	24'-8"	25'-0"	25'-6"	25'-6"	26'-4"
" Width — B	6'-3"	6'-6"	7'-1"	7'-8"	7'-8"	7'-8"	8'-9"	8'-9"	8'-9"	9'-0"	9'-8"	10'-3"	10'-3"
" Height — C	9'-5"	9'-9½"	9'-9½"	10'-3¼"	10'-3¼"	10'-3¼"	11'-3¼"	11'-3¼"	11'-3¼"	11'-3¼"	12'-7¾"	12'-7¾"	12'-11½"
Upper Drum Dia.	34"	34"	34"	34"	34"	34"	34"	34"	34"	34"	38"	38"	38"
Lower Drum Dia.	24"	24"	24"	24"	24"	24"	24"	24"	24"	24"	28"	28"	28"
Dia. Gas Outlet	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"
Shipping Weight Lbs.	20,000	22,000	25,000	27,000	28,000	30,000	33,000	36,000	44,000	52,000	60,000	65,000	70,000

*Based on Feed Water at 212°F and Steam at 100# psi. *Conservative ratings based on 5 sq. ft. per developed hp.*

It's a 2-drum water tube boiler with integral water cooled furnace. Gases travel 3 lengths of the boiler—scrubbing 5 bare metal heat absorbing zones. It's complete—needs only service connections—burns oil or gas or both—requires no stack—no special foundation.

Write for booklet **SB38A.**

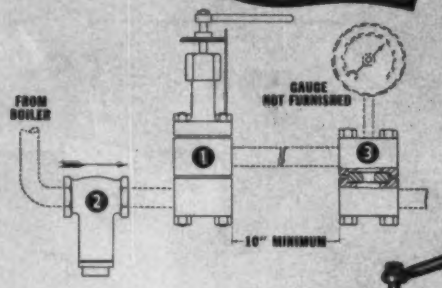
COMPLETE STEAM POWER PLANT EQUIPMENT

ERIE CITY

Complete Steam Generators • Type C 3-Drum Boilers • Types VL & VC 2-Drum Boilers • "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • "Keystone" Packaged Steam Generators • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

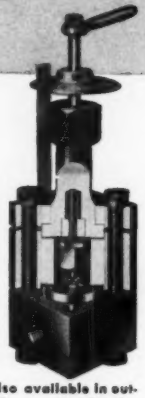
Custom-Built... CONTINUOUS BLOWDOWN



STRONG Dual-Orifice Assembly gives Greater Accuracy . . . Rugged Service!

Strong's Continuous Boiler Blowdown Assembly includes a Strong *block steel* Evrtyte* Valve (1), a strainer (2) and an orifice block (3), *custom-built* and accurately sized for *your own job conditions.*

The assembly is essentially two orifices arranged in series. The first orifice (valve) is variable . . . . the second is fixed. Correct proportioning of orifices provides extremely accurate control and reduces wire drawing.



Also available in outside screw and yoke.

Strong Evrtyte steel valves have special Anum-Metl X seats and discs of 750 Brinell surface hardness for long life. Available for pressures to 1500 psi and temperatures to 800° F. or 6000 psi non-shock cold service.

Let us custom-size your continuous blowdown system. Send for Catalog No. 68-P and our Continuous Blowdown Check-Chart today!

*Reg. Trade Mark

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
Cleveland 13, Ohio

†ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve | 80 Series Trap | Strainer

STRONG

More EQUIPMENT NEWS

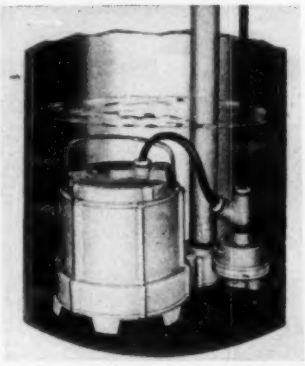
Begins on page 162

put at 18-kv dc for load current variations from zero to 100 ma; line voltage variations from 105 to 135-v ac.

Regulation accuracy ± 1%. Time delay approximately 0.1 second. Easily and quickly modified for power supplies of any output rating.

General Magnetics Inc, 135 Bloomfield Ave, Bloomfield, N. J.

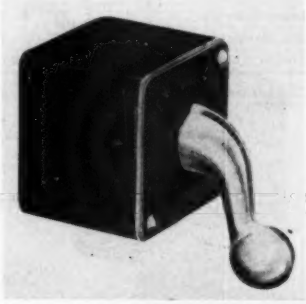
For more data on these items, use post cards, p171. Identify request with P and number.



UTILITY PUMP P1207

Completely submersible pump for many types of sumps in industrial and power plants. Also for draining flooded areas and buildings, pumping out new excavations for buildings and ditches and draining tanks and vats. Unit can pump a sump dry within 5/8 in. of bottom. Pump is compact and lightweight, of all-bronze construction and has capacity of 3300 gph. Motor hp is 1/3.

Keneo, Inc, 1125 N Ridge Rd, Lorain, Ohio



REVERSING DRUM SWITCH P1247

Bulletin 350 Style A drum switch is equivalent of a three pole double throw switch. It is small, simply designed—for machines and equipment requiring economical across-the-line starting and reversing switch for ac and dc motors rated at 2-hp or less.

Housing is bakelite and contains eight

DETROIT ROTOGRATE

REDUCES COAL COST

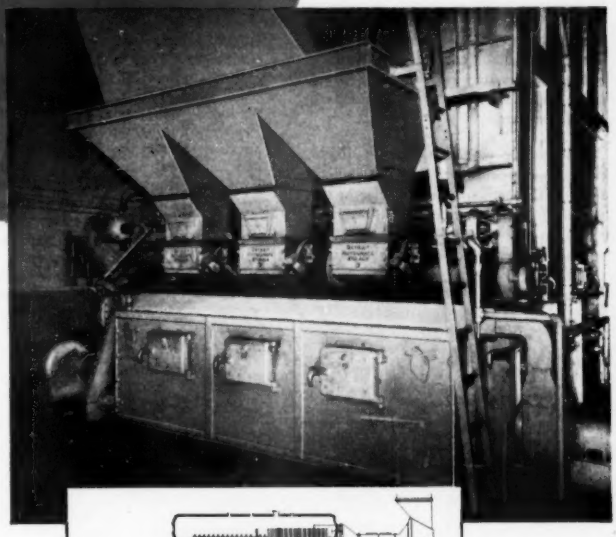
12.6 CENTS PER 1000 POUNDS OF STEAM

AT

Certain-teed Products Corporation

York Pennsylvania Plant

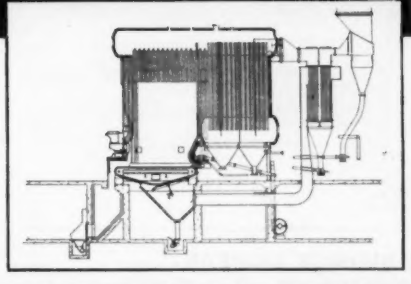
Also Capacity Increased By 479 Tons of Product



Detroit RotoGrate Stoker with Erie City Type VL Boiler at Certain-teed Products Corporation, York, Pa. Capacity 45,000 pounds steam per hour. Operates with preheated air.

THIS Detroit RotoGrate Stoker fired unit has reduced fuel cost 12.6c per thousand pounds of steam at Certain-teed Products Corporation plant at York, Penna., according to report by Mr. W. M. Noon, Combustion Engineer. The reduction in steam cost was made at the same time plant capacity was increased.

The Detroit RotoGrate will save you money and improve your operation. It is the original spreader stoker with forward moving grates that discharge the ash at the front. It handles fluctuating as well as steady loads with high thermal efficiency. • You too can save money with Detroit Stokers. Write for Bulletin.



DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

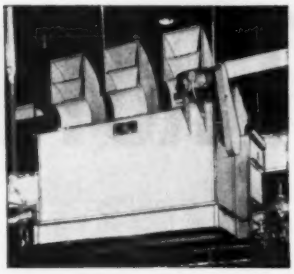
General Motors Building—Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan

New HIGH PRESSURE STEAM Fan Heater

Gives Savings You Never Had Before

The first heater to make High Pressure Steam really trouble-free and practical in plant heating. Every engineer should understand its original method; write for Niagara Bulletin and performance data.



HOW IT OPERATES: — A dual coil system makes use of all heat, both sensible and latent. High pressure steam enters the upper coil, shown on the diagram below. Its condensate drains into a trap. Then this high pressure condensate is released into the header of the lower coil. It instantly flashes into steam at vapor pressure.

Any high pressure condensate that remains liquid is carried to the vapor condensate return header by a drain tube that also gives off its heat into the air stream.

The vapor condenses in the lower coil. Its condensate is kept at a high level in the return leg by a wier in the return header so that all its heat is made useful and it is sub-cooled by contact with the coldest air entering the heater. Vacuum condensate return to boiler is vapor free.

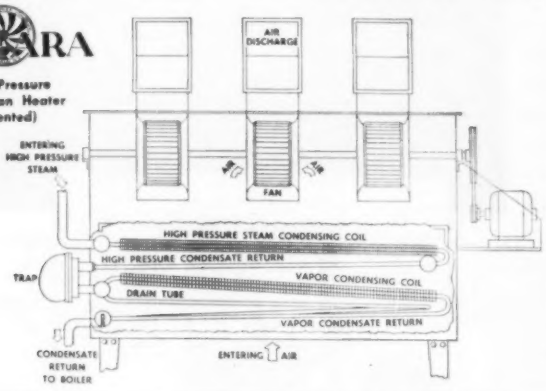
HOW IT SAVES IN COST: — Piping is much simpler and less costly than in low pressure systems. Much secondary piping, traps and big valves are not needed. Pipe sizes are smaller.

HOW IT SAVES IN OPERATION: — Waste is prevented. Every BTU goes where you want it. No dump traps or hot wells waste live steam.

HOW IT SAVES IN UPKEEP: — Condensate flow is even, vapor free, easily handled. No sudden surges of condensate in starting. No hammering, no hard wear and tear on system. Properly engineered for the job, final air temperatures are not excessive; heat easily directed where needed; no flashing of low pressure condensate. Heaters are self-draining on shut-down. Heaters are strongly built; all coils including the condensate drain tubes are hairpin bend, stress relieving. Use thru four heating seasons has proven these advantages in large scale plant heating.

NIAGARA

High Pressure Steam Fan Heater (Patented)



NIAGARA BLOWER COMPANY

Dept. P, 405 LEXINGTON AVE., NEW YORK 17, N. Y.

Please send Bulletin 109 on the Niagara High Pressure Steam Fan Heater.

Name .....

Address .....

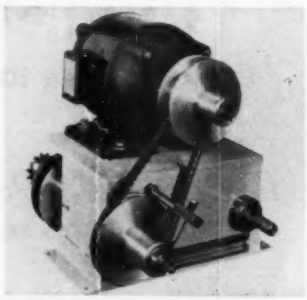
(Advertisement)

More EQUIPMENT NEWS

Begins on page 162

fixed contacts, a moving contact assembly, handle-coverplate assembly, and mounting screws. Contacts are cadmium silver alloy —eliminating maintenance.
Allen-Bradley Co, Milwaukee, Wis.

For more data on these items, use post cards, p171. Identify request with P and number.



VARIABLE SPEED DRIVE P1256

Capacities range from tachometer drives to 10-hp. Ratios up to 50:1 with speed ranges from 150 to 7500 rpm are produced by compounding wide range combination sheaves. Standard NEMA motors of any required electrical characteristics and of either open or explosion proof types are employed.

Prelubricated sealed ball-bearings and precision - built variable pitch sheaves equipped with sintered bronze bushings are incorporated. Regulation with no hunting and nearly complete absence of drifting holds speed variations to less than ¼ of 1%.
Speed Selector Inc, Cleveland, Ohio

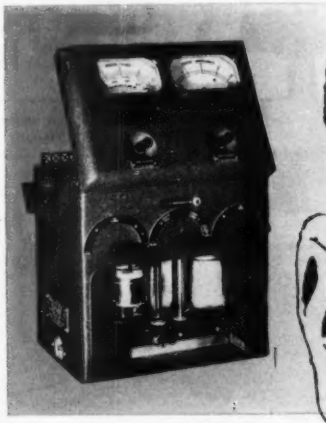
ELECTRONIC MANOMETER AND FLOWMETER P1235

Sensitive electronic manometer and flowmeter, has no glass or plastic tubes and contains no fluids. Operates from a noble metal thermopile.

Two taps on gauge tube connect to two points where pressure difference is to be measured. To use instrument as flowmeter, tube is placed directly in line for low flow rates, or connected to pressure taps on two sides of a calibrated orifice for high flow rates.

Manometer will measure extremely low pressure differences and has a dual range of 0.001 to 0.1 in. and 0.1 to 2 in. water. Instrument may be used for direct indica-

Not an instrument you buy... but a service we supply



Now *within seconds* you can get an accurate and complete picture of combustion conditions in your furnaces. A Cities Service Combustion Engineer, by applying his *exclusive* Heat Prover, will quickly secure continuous, accurate readings that reveal any oxygen excess or waste combustibles present.

Operators throughout the country, by using these instant readings as their guide, have been improving furnace output and product quality, while saving fuel.

Similar results are possible at your plant. Start the ball rolling today for a FREE Heat Prover test of your furnaces. Simply call or write your local Cities Service office . . . or else return the coupon below.

THE COMPLETE CITIES SERVICE LINE FOR THE METAL FABRICATING INDUSTRY INCLUDES

Chillo Cutting Oils Trojan Greases
Trojan Gear Oils Optimus Cylinder Oils
Pacemaker T Hydraulic Oils
Q-T (Quenching and Tempering) Oils

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

CITIES SERVICE OIL CO.
Sixty Wall Tower, Room 246
New York 5, N. Y.

Without obligation please send your booklet, "Combustion Control for Industry."

Name_____

Company_____

Address_____

City and State_____

KENNEDY

bronze globe and angle valves . . .

FIG. 97

JOB-FITTED with the *right* disc for every service

FIG. 98

TO ASSURE LONG, TROUBLE-FREE OPERATION with easy maintenance, the complete KENNEDY Line is *job-fitted* . . . every valve specially designed and engineered for the job it has to do.

IN THE KENNEDY FIGS. 97 and 98, for example, the disc is exactly matched to the job. To meet a wide range of fluid, temperature and pressure requirements, a variety of disc materials is available. Each is carefully selected for the service for which it is recommended.

THE RENEWABLE COMPOSITION DISCS give longer service because the extra height of the raised seats utilizes full thickness of the disc before replacement is necessary. The disc holder swivels on the stem to allow uniform wear on the disc.

THE MOLDED PACKING is self-lubricating and both Fig. 97 and Fig. 98 can be readily repacked under full pressure.

THE HEAVY-WALLED BODIES are ruggedly built with full rounded contour. The stems are made with manganese bronze of 50,000 lb. tensile strength and have unusually heavy threads. Parts are fully interchangeable. Sizes range from ¼ to 3 inches with a working pressure of 125 lbs. saturated steam, WRITE FOR BULLETIN 56.

BUY FROM YOUR LOCAL DISTRIBUTOR

Est. 1877

THE **KENNEDY**
VALVE MFG. CO. • ELMIRA, N.Y.

VALVES • PIPE FITTINGS • FIRE HYDRANTS

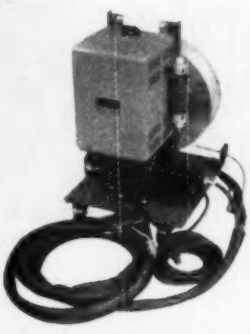
More EQUIPMENT NEWS

Begins on page 162

tions or attached to a recorder. Calibration and accuracy are not affected when long extension cables are used from gauge tube to the meter.

Hastings Instrument Co, Inc, Super Hwy and Pine Ave, Hampton 10, Va.

For more data on these items, use post cards, p171. Identify request with P and number.

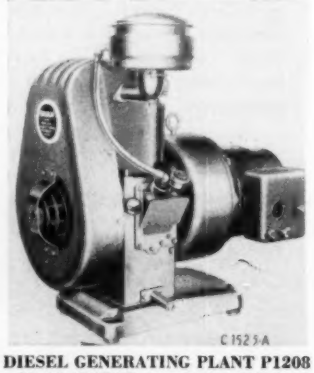


FILLER METAL **P1219**

For use with gas-shielded arc welders, *Fillerweld* allows welding machine operator to control continuous flow of filler-metal automatically by means of finger switch mounted on the torch.

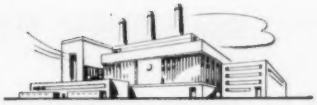
Fillerweld consists of two main elements —a torch or gun and a mechanical power unit. Gun is a manual, water-cooled inert-arc tungsten holder. Has a control switch and gear assembly for pulling the filler-metal through the gun. Mechanical element has a motor, a Thy-mo-trol control, and a spool for filler-metal.

General Electric Co, 1 River Road, Schenectady 5, N. Y.



DIESEL GENERATING PLANT P1208

Model 3DSP-1E is a 3000-w full-diesel generating unit. Push-switch control for electric cranking, manual compression release and an electrically heated glow plug



Here's REAL ECONOMY in AIR POWER for POWER PLANTS

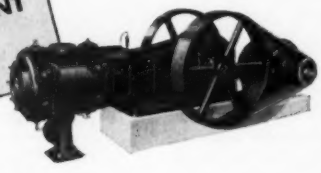
Ingersoll-Rand can supply the right compressor for ALL THREE power plant applications

1. GENERAL SERVICE AIR

XLE Compressors

This new, compact, packaged-design, electric-driven compressor sets new standards of performance and economy in supplying general service air for power plant use. It's a heavy-duty, completely self-contained, two-stage unit producing pressures of 80 to 125 psi. The new "L" Design—with Pipeless Thru-Frame Air Flow, built-in tube-and-finned intercooler, and crankshaft-mounted synchronous motor—saves floor space, cuts installation cost and reduces maintenance.

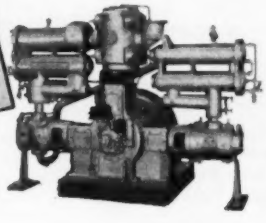
2. INSTRUMENT AIR



ES-NL Compressors

The famous I-R Class ES compressor—with NL (non lubricated) cylinder—is the most dependable and efficient source of oil-free air for operating pneumatic control instruments. The heavy-duty ES compressor meets the most exacting requirements for instrument air systems, where dependability and continuity of service are essential. The NL cylinder is fitted with graphitic carbon supporting and pressure rings, requiring no oil, grease, water, or glycerine for lubrication.

3. SOOT BLOWING



TVH Compressors

This three-stage compressor, with discharge pressures of 350 to 500 psi, has been especially developed for heavy-duty soot-blowing service. Inverted "T" design, with self-contained interstage cooling, assures high over-all efficiency, low discharge temperatures, and smooth running balance. Floor space requirements are reduced and easy accessibility of all parts simplifies inspection and maintenance. Available with direct-connected motor drive.

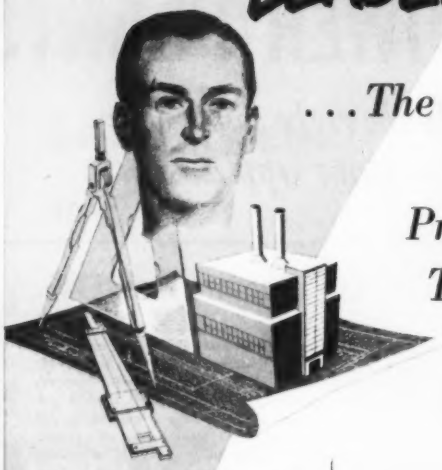
694-1

● All of these compressors have one thing in common—Ingersoll-Rand's traditional dependability and performance. That's your best assurance of minimum operating and maintenance expense, with important long-term savings that mean real economy in air power equipment. Your nearest I-R representative will be glad to give you complete information on the compressors best suited to your needs.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

LEADERSHIP



...The Result of Progressive Thinking

THE big reason for America's industrial leadership is Management's studied practice of progressive thinking which points the way to orderly advance along sound, constructive lines.

Evidence of this is clearly indicated by the growing tendency of Management to utilize the specialized services of independent consulting engineering organizations which in a single service provide completely coordinated staffs of architectural, civil, chemical, electrical, and mechanical engineers highly skilled and experienced in their respective fields.

The Peter F. Loftus Corporation is such an organization and has over the years cooperated with the management and engineers of utilities, industrials, institutions, and governmental agencies in such vital matters as modernization programs, new plant designs, expansions and related projects.

Peter F. Loftus Corporation
Established 1923
ENGINEERING CONSULTANTS
First National Bank Building, Pittsburgh 22, Pennsylvania

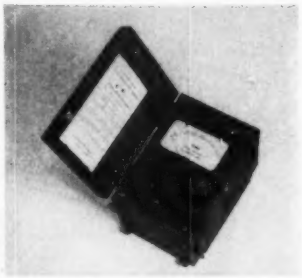
More EQUIPMENT NEWS

Begins on page 162

for cold-weather starting are provided. Compact and easily installed unit generates 115-v 60-cps single-phase current. Other single-phase ac models produce 230 v and 115/230 v. A 32-v battery-charging model is also available.

D W Onan & Sons Inc, University Ave SE at 25th, Minneapolis 14, Minn.

For more data on these items, use post cards, p171. Identify request with P and number.



SOIL-RESISTIVITY METER P1248

Model 243-A *Vibroground* is a direct-reading meter for measurement of soil resistivities from 0 to 30,000 ohms per cubic centimeter. Weight (with batteries) is 9 lbs; overall size is 9x6x6½ in. Power is provided by 8 standard No. 2 flashlight batteries.

Associated Research, Inc, 3770 W Belmont Ave, Chicago 18, Ill.

DIESEL DEHYDRATOR P1225

Increased combustion efficiency, reduced carbon formation, less corrosion of working parts results from use of dehydrator in diesel fuel supply system. Wound cellulose cylinders, specially treated coalescing media, perforated metal and glass cloth make up the dehydrator. No moving parts are needed. Both free and entrained moisture is removed. Capacities from 350-600 gpm at maximum working pressure of 125 psi.

Bowser Inc, Fort Wayne, Ind.

ELECTRONIC STETHOSCOPE P1253

Instrument helps locate friction noises in bearings, pistons, gears, ratchets, cams, clutches, traps, pipe lines, valves and other mechanisms. *Elec-Detec*, electronic stethoscope, employs metal probe which serves as microphone transmitting impulses electrically to headphones.

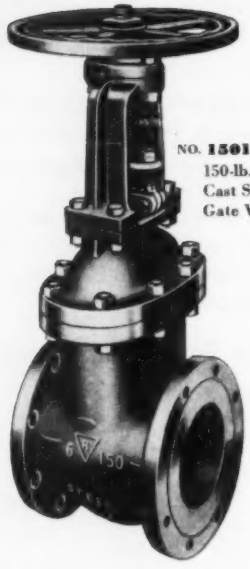
It localizes source of tell-tale noise, helps diagnose the trouble and determine quickly where to make repairs without tearing down entire equipment. Unit detects sounds at low speed that otherwise could be heard only at high speed.

Even tick of a fine watch and sounds not normally audible are clearly defined; air-borne sounds do not register.

Anco Instrument Div, 4254 W Arthington St, Chicago 24, Ill.

POWELL
is more than
a name
It's the hallmark of better quality in valves. That means better performance, longer life and lower cost of maintenance.
Also because Powell makes the valve to suit the service, you have at least two reasons why there are more types of Powell Valves serving industry today than any other make.
The Wm. Powell Co., Cincinnati 22, Ohio
Fig. 11303 W. E. Series 1500-pound, Cast Steel, Pressure Seal Gate Valve with welding ends. One of many Powell designs for Power Plants.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

R·P&C VALVES



NO. **1501**
150-lb.
Cast Steel
Gate Valve

Throughout Industry—It's R-P&C for Quality Cast Steel Valves

- R-P&C Cast Steel Valves are on the job throughout industry helping to maintain uninterrupted production with their long and trouble-free service.
- Your R-P&C distributor has them—or can get them for you. Your nearest R-P&C district office will gladly furnish details about the line.

ACCO
Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

"Intentionally Better"
READING-PRATT & CADY VALVES

My Biggest Boner

► OUR CHIEF ALWAYS told us to think before we ever did anything in a power plant. The one time I forgot to think I really had to face the music. And it sounded like accordion music. Here's why.

One of our closed feed heaters had a good bit of oil in it. The Chief told me to boil it out, using a compound that would take the oil off the tubes and shell. "Flush it after it's clean," he said as I left his office.

We boiled the heater out. Only that day neither my helper nor myself seemed to be thinking. Because the first thing we did was allow steam to blow through the heater-trap bypass into the hotwell. We stopped that and let the heater boil. When we figured it was clean we opened it.

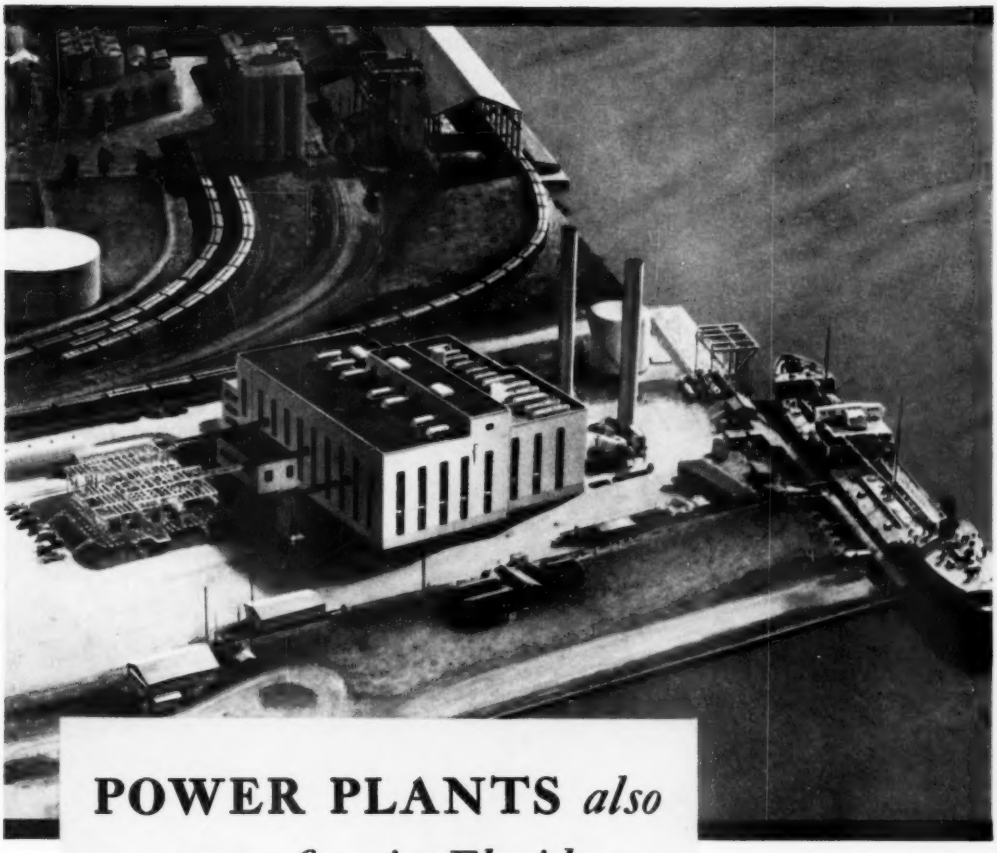
On the bottom of the heater there was a pile of scale that had fallen off the tubes. I told my helper to get a hose and flush it out.

I heard water start spraying from the hose and then there were several awful sounding snaps and cracks. I looked into the heater and began to hear accordion music. My helper had used *cold water* to flush the heater shell. When hit by the cold water the hot tube nest had folded neatly, just like an accordion.

We were almost fired but that didn't scare me as much as the fact that I had forgotten the Chief's words, "Don't ever do anything in a power plant without thinking first."

FREDERICK O MEYER
Bogota, N. J.

• What is your "biggest boner"? We'll pay ten dollars for each one we publish



POWER PLANTS *also grow fast in Florida*

The Hookers Point Station of the Tampa Electric Company, located on the Sparkman Channel, near the southeastern limit of the city. The first 30,000 kw capacity was completed in 1948.

THE 30,000 kw capacity of Tampa Electric Company's Hookers Point Station, designed and constructed by Stone & Webster Engineering Corporation, was tripled in 1950 with the completion of a 60,000 kw extension. A further expansion, now under way, will raise the name-plate capacity of the station to 130,000 kw.

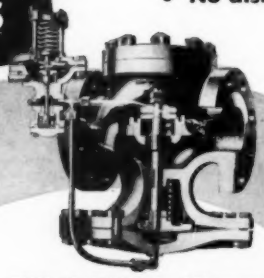
STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

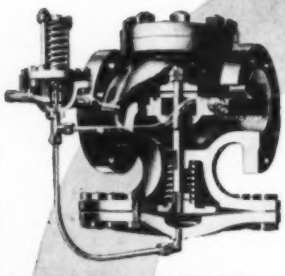
SAVE WITH SPENCE on all these jobs

Here are a few reasons why Spence Regulators give you accurate regulation and long, trouble-free life:

- **Single-seat Packless Construction**
- **Large Balanced Metal Diaphragm**
- **Sensitive Pilots**
- **SECO Metal Seats and Discs**
- **Springs out of path of steam**
- **No dismantling for inspection**



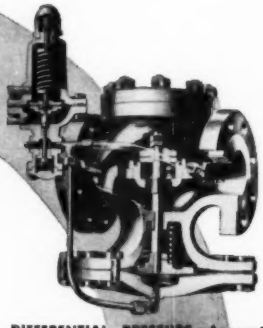
PRESSURE REDUCING—Self-operated, dead-end regulators powered by large, frictionless, metal diaphragms. Sizes ¼ in. to 12 in. Pressures to 600 psi 750 F.



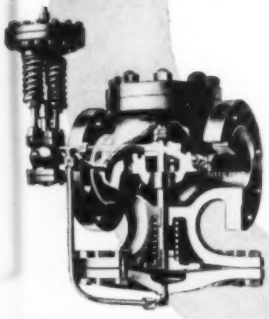
BACK PRESSURE CONTROL—Wide selection of sensitive pilots to meet exacting requirements. Initial pressure closing, guaranteed to shut tight. Packless construction, metal diaphragms.

WRITE FOR BULLETIN 350

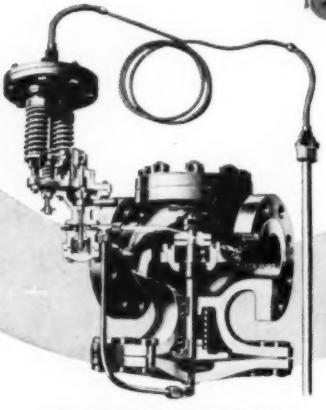
for complete details on Spence's line of automatic regulating valves



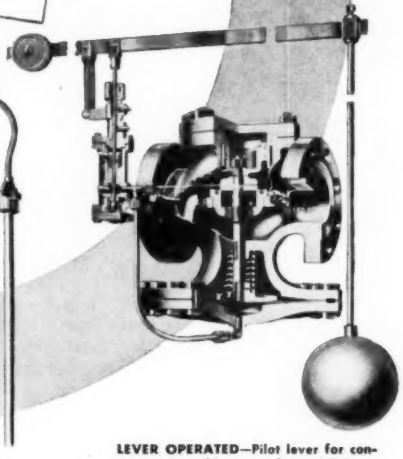
DIFFERENTIAL PRESSURE—Accurate control of delivery pressure at a constant, adjustable differential from 3 to 150 psi above another source of fluid pressure.



PUMP GOVERNOR—Constant or excess pressure control for steam pumps. Steam pressures to 600 psi 750 F, pump discharge pressures to 2000 psi.



TEMPERATURE REGULATING—Combined temperature and pressure control. No separate reducing valve required. Shuts tight, will not wiredraw or be damaged by overheating. Sizes to 12 in.



LEVER OPERATED—Pilot lever for connection by cable or mechanical linkage to floats or other devices. Slight actuator motion opens and closes main valve.

48-112

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence

THE ANCHOR PACKING COMPANY

Chrometite GASKETING

Provides economies in original cost and LONGER SERVICE!

BRANCH OFFICES

BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N. Y.
CINCINNATI, OHIO
CHICAGO, ILL.
CLEVELAND, OHIO
DAYTON, OHIO
DETROIT, MICH.
HOUSTON, TEX.
INDIANAPOLIS, IND.
LOS ANGELES, CAL.
MILWAUKEE, WIS.
MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N. Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO
WILMINGTON, CAL.

CHROMETITE is ideal for corrosion proof, water, air and dust-tight sealing of all faying surfaces such as lapped, butted, or flange type joints. Especially is it suitable as an easy-to-wrap covering for cold water pipes.

CHROMETITE Gasketing is a high grade felt containing wool, impregnated to guard against corrosion and adhere to metal, glass, wood, concrete and plastics. No odors. No cleanup. Cuts application man-hours and over-all gasketing costs.

Write today for full details on this superior Anchor Gasketing material.

Manufactured by Products Research Company, Glendale, California

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

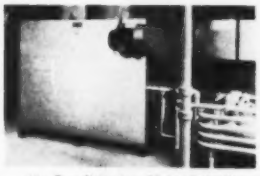
FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

Don't be fooled...

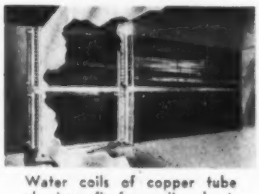
Radiation can sometimes fool the "experts." Four tin cans — one painted white, one black, one highly polished and one covered with asbestos, after being filled with boiling water will cool at different rates. Which should cool most rapidly? Fill four cans as shown and record temperatures. Kirchoff's law still holds!

Radiation, conduction or convection — Bush finned surfaces offer high heat transfer coefficients meaning greater economy in coil size for a given load. Heating or cooling for product or comfort, there's a Bush unit to answer the need. Write for catalogs 350 and 425 which describe the Bush line and in addition contain valuable engineering data.



Air Conditioning Units 2 to 70 tons capacity for cooling, heating. 1800 to 18,000 CFM.

Standard Pipe Radiation. For heating. Copper tube, aluminum fin or all steel.



Water coils of copper tube aluminum fin for cooling, heating. Wide variety of sizes.

Cooling Towers and Evaporative Condensers 3 to 75 tons. Cuts water consumption 90%.

BUSH MANUFACTURING COMPANY

WEST HARTFORD 10, CONNECTICUT

MARMADUKE

Continued from page 150

beneath the oil, it takes plenty of heating before the transfer pump can lift that oil into the settling tanks for burning.

"The returns from all oil-tank heating coils, both lube and fuel, emptied into the inspection tank above the hotwell. But there was no trace of oil in that tank. So none of the oil heating coils brought back oil.

"But where else could the oil come from? There just wasn't any other equipment with fuel on one side and steam on the other. Finally, I yanked the door off the closed feedwater heater. Her copper steam coils were coated with oil. Boy, what a surprise!

"Exhaust steam from the auxiliary pumps, such as feed-, ballast-, bilge-, fuel- and fuel-transfer pumps exhausted into the feed heater at 13 psi. BUT HOW IN HELL COULD FUEL OIL GET INTO AN EXHAUST STEAM LINE?

"I broke a flange on the fuel-oil service pumps' exhaust line, but there was no trace of oil. Then I broke the flange on the exhaust line from the big fuel-transfer pump that lifted oil from the double bottoms into the settling tanks. The inside of that exhaust line was coated with oil. Now we were getting warm.

"I removed the big duplex transfer pump's steam-valve chest cover. Then I saw something I hadn't seen or heard of in years of steam engineering. That valve chest was coated with fuel oil. I got the ship's chief engineer.

"'Has this transfer pump been overhauled lately?' I asked.

"'Sure,' he answered. 'My second assistant put in new piston rings, new rods and overhauled the valve chest just about the time we first found traces of oil in the boilers. That was ten days out of Yokohama on our way home.'

"'That's all I want to know,' I told him.

"I had my boys remove the pump's piston rods. The rods were made of 1½-in.-diameter bronze. They were about five feet long. We washed the rods in kerosene and removed every speck of fuel oil. I examined the rods but found nothing wrong. Then I did a little brainwork. I came to the conclusion there was no way for that fuel to get into the steam end but *through* the rods.

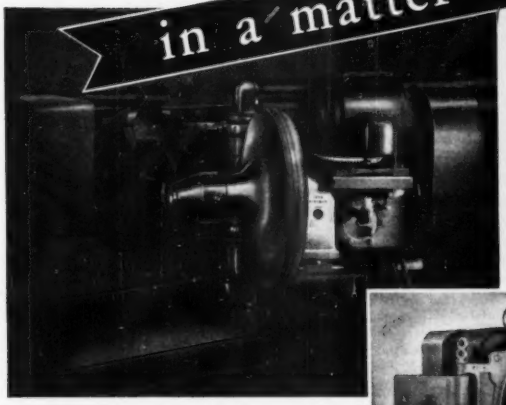
"I had the machine shop make a fitting to couple the machine threads on the rod's end with an air hose. Then I gave the hose 100 psi air. That did it.

"The white bulkhead I pointed the rod against got splattered with fuel oil

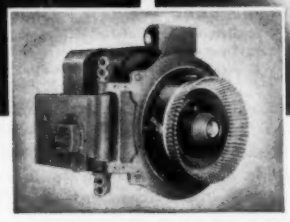
from GAS to OIL

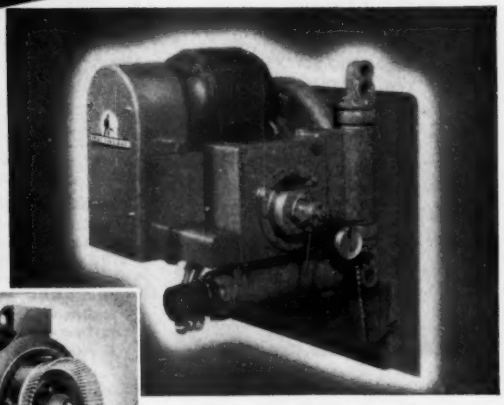
in a matter of *minutes*

and vice-versa



Above, the Iron Fireman Ring Type gas burner takes over the firing job, with the Iron Fireman Horizontal Rotary oil burner swung back from firing position on boiler front. Right, firing end of Iron Fireman combination gas-oil burner.





Above, Iron Fireman Horizontal Rotary oil burner in firing position. Removal of center plate in gas burner permits insertion of oil burner nozzle in center of gas ring. For long periods of oil firing, gas ring is customarily removed.

Meet fuel emergencies with IRON FIREMAN combination firing

Only a few minutes notice is required to switch from one fuel to another. The Iron Fireman gas-oil burner guards your buildings or plant against sudden fuel emergencies, or against daily or seasonal gas shortages due to peak demands. You may also take advantage of changing fuel prices or seasonal rates.

The Iron Fireman Ring Type gas burner operates equally well with natural, manufactured or mixed gas, or with forced or natural draft.

The Iron Fireman Horizontal Rotary oil burner fires any grade of oil without special adjustment, from lightest to heaviest (No. 6). The exclusive Iron Fireman Oil Volumeter maintains extremely accurate oil flow regardless of changes in oil viscosity. Heat-rich, low-cost industrial oils can be fired as easily as the refined domestic oils.

Every installation is engineered for most efficient application to your individual requirements. Sales and engineering service throughout U. S. and Canada.

Write for 16-page illustrated booklet and specification sheets, to Iron Fireman Mfg. Co., 3135 W. 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. Dealers everywhere.

IRON FIREMAN

OIL, GAS and COAL FIRING FOR POWER, PROCESSING OR HEATING

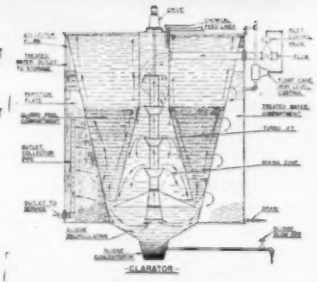
FOR CLARIFICATION, STABILIZATION NEUTRALIZATION, CHLORINATION PURIFICATION, ALKALINITY REDUCTION SOFTENING, SILICA REMOVAL, IRON REMOVAL, CONTROLLED CONDITIONING

The Belco CLARATOR

Advantages:

1. RAPID CHEMICAL SLUDGE CONTACT
2. SIMPLICITY OF OPERATION
3. VARIABLE OUTLET FLOW
4. SEPARATE STORAGE COMPARTMENT
5. COMPACT
6. AUTOMATIC CONTROL
7. LOW TURBIDITY

Looking into Belco Clarator



Essential Components of the Clarator:

1. Raw water inlet pipe
2. Automatic Desludger
3. Central mixing compartment
4. Overflow flumes
5. Turbo-Jets
6. Sludge concentrator
7. Treated water compartment
8. Axial flow slurry recirculation pump

The Belco Clarator is designed to handle all types of water treating problems. Essentially the process design of the Clarator and unit operation is identical for all problems. The differences lie in the type and quantities of chemicals used to achieve a definite treated liquid effluent. The raw water enters the mixing compartment at the top of the Clarator with automatically fed dosages of chemicals so that chemical reaction takes place immediately. Slurry particles rapidly grow in size by accretion and pass to the slurry compartment. The treated water flows around the perimeter of the tank to the outlet. Heavy particles of sludge collect and settle at the bottom of the concentrator where it is automatically discharged.

Complete description and color illustrations in Bulletin 108. Ask for your copy.

Belco engineers are prepared to give you authoritative assistance and close cooperation on all water treatment problems.

Belco

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
PATERSON 3, NEW JERSEY
Processes for Removal of Water Impurities

Belco Clarator installed in New York City for clarifying East River water.

MARMADUKE

Continued from page 208

Then air hissed out of the lathe center on the rod's end.

"I put a magnifying glass against the center. There I saw a crescent-shaped hole, about ¼ inch long, at the center's bottom. So that's where the oil came from. It was forced through the rod from the pump's oil end, right into the steam cylinder.

"'Here's your trouble,' I told the super, laying the rod on his desk.

"'You've been ballasting your tanks again,' he snorted. But I handed him the magnifying glass.

"'Now I've seen everything,' he exclaimed, looking dumber than usual. He got on the phone and called the supply house. They gave him the name of the rolling mill in Cleveland that made the rod's bar stock. He called them long distance.

"'Once in a blue moon,' came back the works manager's voice from the other end, 'a bronze rod is rolled that has a crescent-shaped hole through it. But I've only heard of one other case, and that was over 20 years ago.'

"Who was to blame?" wound up Marmaduke, getting back to his indicator cards, "Don't ask me. All I know is it cost eighty thousand dollars in repairs, not to mention ship delay losses. And all for a tiny hole through a pump rod."

"Now see if Don Swift can top that one?" barked the old salty trouble-shooter, adjusting his magnifying glass over an indicator card as Ben Skrotzki and I walked out through the door.

EDITOR'S NOTE: Can you readers top that story? This incident *did* happen.

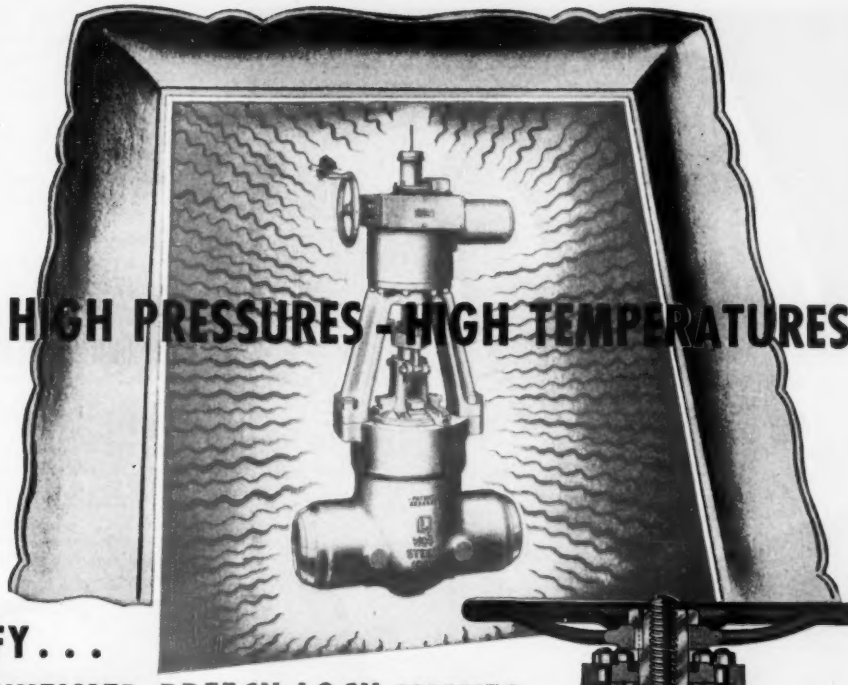
GAS TURBINES

Continued from page 73

Brown Boveri engineers conclude from their experience that difficulties caused by ash in oil are aggravated and intensified by high turbine-inlet temperatures. They establish a maximum operating temperature of 1200 F in the interest of reliability and long life.

Research now under way on ash removal or neutralization, treatment by chemical additions, protective coatings, etc. Work has not gone far enough to draw conclusions. An interesting observation is made that most troubles today are blamed on vanadium content of oil ash. There are, however, strong indications that presence of sodium (even in form of sea water) greatly increases aggressiveness of vanadium salts on their tendency to form deposits.

Report concludes that the major field



FOR HIGH PRESSURES - HIGH TEMPERATURES

SPECIFY . . .
LUNKENHEIMER BREECH-LOCK VALVES

—Proven by 15 YEARS of dependable service

The trend to higher steam pressures and temperatures continues. To meet this trend, power engineers are specifying Lunkenheimer Breech-Lock Valves for service all the way to 2100 psi and 1050°F. Check these points:

- The patented Lunkenheimer Breech-Lock Design eliminates gaskets, rings, flanges and bolting materials that cause leakage at high pressures and temperatures.
- The intermeshing lugs in body and bonnet carry full internal pressures, distribute stress evenly.
- "Breech-Lock" has been proven by *fifteen years* of reliable service in the field.

Meet the trend in your own plants by standardizing on Lunkenheimer Breech-Lock Valves — value-proved for fifteen years. *And write today for your copy of "Lunkenheimer Cast Steels," an informative brochure on high-temperature, high-pressure alloys. Address: The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio.*

BREECH-LOCK GATE VALVE

IRON • STEEL • BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-451-B

. . . NEW Heat Saving Efficiency

MUNDET 85% MAGNESIA INSULATION provides maximum strength and resistance to vibration. Extra durability is built into this insulation. In pipe covering and blocks, it is precision manufactured on the latest type of automatic equipment to insure uniform standards. It does not "powder", settle or disintegrate. It is unaffected by steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation when you specify Mundet 85% Magnesia Pipe Covering and Blocks. *Write for new heat insulation Engineering & Specification Data Manual.*

Mundet Cork Corporation

Insulation Division, 7107 Tonnelle Ave., North Bergen, N. J.

Mundet district offices are located in these cities:

ATLANTA 339-41 Elizabeth St., N.E.
BALTIMORE 30 612 Battery Ave.
BOSTON 57 Regent St., N. Cambridge 40
CHARLOTTE 3, N. C. 507 S. Cedar St.
CINCINNATI 2 427 West 4th St.
DALLAS 10 651 Second Ave.
DETROIT 21 14401 Prairie Ave.
HOUSTON 1 Commerce and Palmer Sts.
INDIANAPOLIS 4 15 E. Washington St.
JACKSONVILLE 6, FLA. 805 E. Bay St.
KANSAS CITY 7, MO. 1401 St. Louis Ave.
KNOXVILLE 1221 Grand Ave.
LOS ANGELES (Maywood): 6116 Walker Ave.
In Canada: Mundet Cork & Insulation, Ltd., 25 Booth Ave., Toronto
NEW ORLEANS 16 315-25 N. Front St.
NEW YORK 17 331 Madison Ave.
PHILADELPHIA 39 856 N. 48th St.
ST. LOUIS 9 3176 Brannon Ave.
SAN FRANCISCO 7 448 Brannon St.

INSULATION FOR HIGH & LOW TEMPERATURE

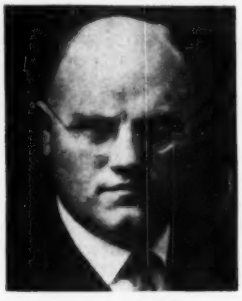
of application for the next few years will be in small and medium-sized units. Present capacities range from 1200 to 10,000 kw in eight standard sizes. The larger and more complicated units in 2-shaft arrangements, while as reliable as smaller units, are somewhat handicapped by high cost of additional heat exchangers and connecting piping. Broad use may well await further development in metallurgy and fuel chemistry. This will allow advancing into higher operating temperatures without the present hazards.

WITH OUR READERS

Continued from page 5

body was shouting. Amidst this tumult came Al's drawling reply, "The important question now is who has a chew of tobacco?" And the giant mirror *was* saved.

Born in Norway in 1886, Alfred Vaksdal got his engineering degree in that country. His first U. S. job, about 1910, was designing an incinerator plant for Chicago. He joined Corning Glass in World War I,



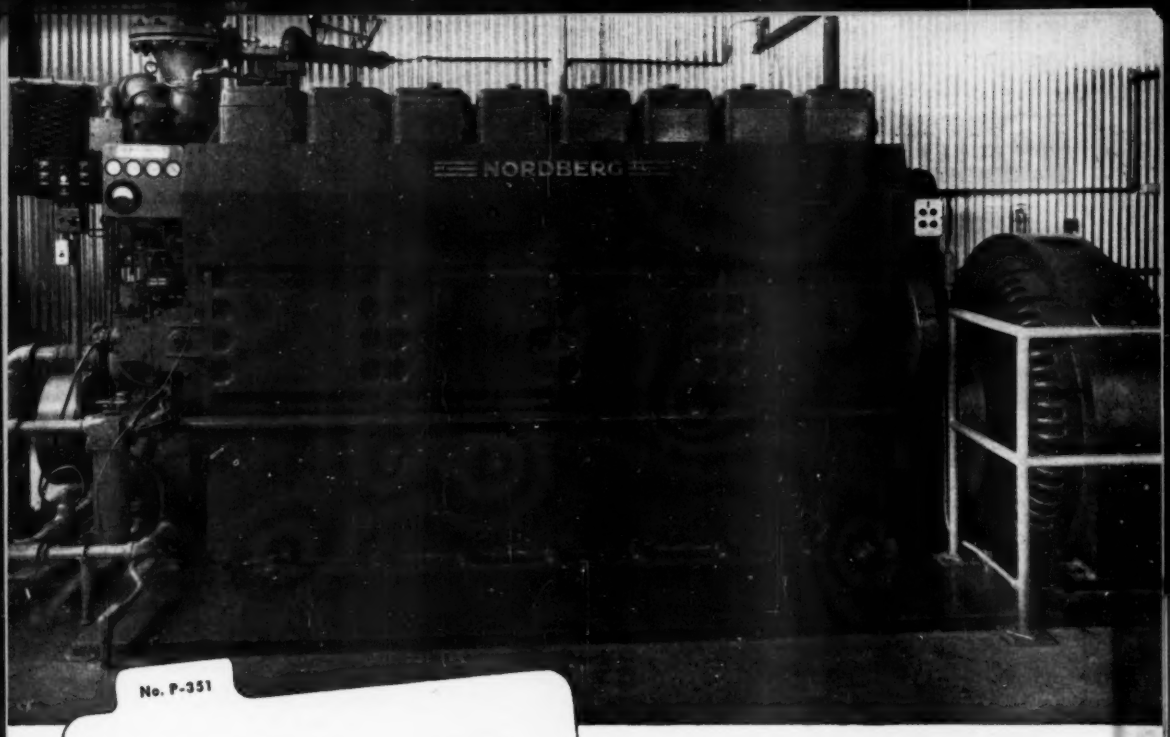
Alfred Vaksdal

and continued with them until his death. For many years he was plant engineer at Corning.

In 1945, Al became chief engineer for new plant construction and supervised the selection of sites for new Corning plants at Muskogee, Okla.; Albion, Mich., and Danville, Ky. He was busy with Danville at the time of his death.

Al Vaksdal was active in professional circles, and in public and church affairs of Corning. Many other cold facts could be set down for the record, but to me what matters most is that my good friend Al Vaksdal was a big, plain man—an engineer's engineer and a man's man.—*Phil Swain*

The American Standards Assn Subcommittee Y10.2 (formerly Z10.2), Letter Symbols for Hydraulics, has been reconstituted to review and revise the 1942 Standards on Letter Symbols for Hydraulics. Comments and suggestions are requested by the Chairman, Dr J M Robertson, PO Box 30, State College, Pa.



No. P-351

THE CASE OF THE STAND-BY DIESEL that paid for itself in *FIVE MINUTES*

NORDBERG DIESELS FOR EVERY POWER REQUIREMENT....10 TO 9600 H.P.

For regular or emergency service, you can't beat the advantages of Nordberg Diesels . . . they can be added to the line quickly, and can be held ready for instant service without exorbitant stand-by expense . . . and in the complete line of Nordberg two and four-cycle Diesel engines, including both oil and gas burning types, you will find exactly the right unit to meet your present and future power requirements . . . in sizes up to 9600 hp.

THIS 8-cylinder 720 hp Nordberg Supercharged and Intercooled Diesel is connected to a 500 kw AC generator for emergency power needs at the big Owens-Corning Fiberglas plant at Santa Clara, California.

With the process at this particular plant, an interruption of power for more than 5 minutes' duration could raise havoc with the processing machinery. To guard against any such shutdown caused by a failure of purchased power, the Nordberg Diesel is ready to take over the plant load at once. To make sure full power is instantly available, the engine is constantly maintained at operating temperature. Once each day the engine is started, paralleled with purchased power, and the plant load taken over for a short period . . . assuring its readiness, and familiarizing personnel with rapid operating procedure.

Since this installation was made, eight main power failures have occurred without warning. *In each case, the Nordberg stand-by unit was on the line and supplying emergency power within three minutes.* This service has more than saved the Diesel's original cost.

Here, then, is proved Nordberg Dependability . . . *Ready for instant service!*

NORDBERG MFG. CO.
Milwaukee 7, Wis.

P-351

BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

Damper Regulators

Sensitive — Hydraulic — Automatic

ATLAS

TRADE MARK REG

WHAT THEY DO

1 — ATLAS Damper Regulators continuously maintain the desired pressure in steam boilers by automatically adjusting the boiler drafts or dampers.
2 — On forced draft boilers they may be arranged to control the speed of the fan.
3 — From the fan they may then be made to indirectly regulate the rate of feed of stokers on stoker fired boilers.
4 — By regulating the draft they reduce the amount of air used to the desired minimum, air inleakage through boiler settings being simultaneously minimized.
5 — It is plain that with air volume minimized a higher and more efficient furnace temperature is attained and maintained. The modern engineering trend is toward higher furnace temperatures. Radiant heat varies as the "fourth power" of temperature. ATLAS regulation causes a vast increase in radiant heat.
6 — CO_2 is kept where it should be and CO is avoided.
7 — Much fuel is saved by reducing the volume of air used, eliminating CO, and keeping the chimney gas temperature down where it belongs.
8 — ATLAS Damper Regulators save labor. Without an ATLAS it is necessary to regulate boilers "by hand." Hand regulation is far inferior to ATLAS automatic regulation. Hand regulation costs much more for labor and, even when watched CONSTANTLY, gives a lower boiler efficiency than ATLAS control.
9 — In view of the above it is clear why ATLAS Damper Regulators quickly pay for themselves. Installed on almost any boiler, they are an important economy factor.

The Damper Regulator shown at the right is No. 502. For boiler pressures up to 150 pounds. Will move damper on boiler pressure changes of ¼ pound.

Ask for Bulletin 4-A which Tells All

Bulletin 4-A explains in full why ATLAS Damper Regulators are so valuable on boilers of nearly every size and type. You can get a copy by using the coupon at the right. Also, note the other ATLAS products listed in the coupon.

ATLAS VALVE CO., 289 South St., Newark 5, N. J.
☐ Please send Bulletin No. 4-A on ATLAS Damper Regulators. Also, please send information on the following ATLAS Products.

☐	CAMPBELL Boiler Feed Regulator	☐ Pump Governors
☐	Temperature Regulators	☐ Humidity Controllers
☐	Reducing Valves	☐ Thermostats
☐	Exhaust Control System	☐ Balanced Valves
☐	Pressure Regulators	☐ Control Valves
		☐ Oil Control Cocks

Name .....
Firm .....
Street .....
City ..... State .....

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

Specialists in Regulation for Over a Half Century

289 South Street • Newark 5, New Jersey

Represented in Principal Cities

BOOKSHELF

Fuel Oil Manual *(1951—1st edition). By Paul Schmidt, chief chemist, Allied Oil Co, Inc, 160 pp, 6x9 in., illust, 34 tables, simulated leather. $3.50. Industrial Press, 148 Lafayette St, New York 13, N. Y.*

For those who buy, sell or use fuel oil for heat-treating, building heating, power service. Discusses the properties of fuel oil, limitations and applications of each grade, methods to assure uniform quality, the way oil is refined.

Author suggests ways to diagnose fuel-oil troubles, steps to reduce them. Twenty-two specific troubles, their symptoms and remedies are listed.

Other practical items are storage methods for fuel oil, heats of combustion, fuel-oil treatments, blending of different oils. Major complaints and possible causes of trouble in fuel-oil specifications are also given.

Engineering Graphics. *(1951). By John T Rule, professor of graphics, and E F Watts, Massachusetts Institute of Technology. 298 pp, 9½x6¼, illust, tables, $3. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 18, N. Y.*

A new approach to theory and application of engineering drawing. Rather than concentrate on working drawings and details of standard practice in established special fields, book gives basis for application of graphical analysis methods. Covers three types of geometry having practical engineering uses (1) synthetic, (2) coordinate and (3) descriptive. Synthetic geometry concerns constructions, such as, conic sections, projections and vectors. Coordinate geometry deals with graphical scales, empirical curves, monograms and graphical calculus. Descriptive geometry covers orthographic projection, axonometry and related subjects.

Contains material that originally was scattered through the literature. Serves well as introduction to subject and as handy reference for the practising engineer.

Transients in Power Systems *(1951). By Harold A Peterson, chairman of Electrical Engineering Dept, University of Wisconsin. 361 pp, 6x9, charts, diagrams, $6.50. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

Combination reference and text book primarily for engineers in power system and apparatus design.

Tools like the differential analyzer and transient analyzer have greatly extended the range of transient phenomena that can be analyzed successfully. Author has organized results of many investigations with these improved tools. Presents significant data in convenient, quickly usable form. Much of the information has never been published before; the rest is scattered throughout the literature.

Not restricted to the rigorous mathematical circuit-theory approach. Discusses what the analysis discloses and what conclusions can be reached that will help the

better measurement and control of

HUMIDITY

Ever since the origination of accurate humidity control by Foxboro, this Company has been foremost in the development of instrumentation for absolute humidity, relative humidity, moisture content and dew point . . . whether in gas, air, bulk materials or moving sheet stock. The high quality standards and complete diversity of Foxboro Instruments . . . backed by Foxboro's broad experience . . . offer you unmatched facilities for obtaining the most efficient system for your operation.

INDICATORS • RECORDERS • CONTROLLERS

hygroscopic, wet-and-dry bulb, capacitance, plus the unique "Dewcel" system for continuous recording and control of either absolute humidity or dew point.

TRANSMISSION SYSTEMS • CONTROLLED VALVES

FOXBORO

Reg. U. S. Pat. Off.

...specialists in the measurement and control ... pressure, flow, liquid level, humidity . . .

THE FOXBORO COMPANY, FOXBORO, MASSACHUSETTS, U. S. A.

STOP
Polluting the Air
With

WASTED DOLLARS

Air pollution often goes hand in hand with inefficient power plant operation. It is only one of the many problems accompanying the serious demand for increased production at lower operating costs.

Whether it's air pollution or more power, or both, your problems can be solved effectively by the Ferguson *First Team* approach—men carefully selected for their training and experience in the power field—men who work smoothly and efficiently together, and *with your organization.*

Ferguson is aware that individual problems must be treated as such—therefore, thorough preliminary investigations are made in the light of plant modernization, renovation of existing facilities—or the need for completely new construction to affect economic operation.

Preliminary Discussion in Confidence and Without Obligation.

THE H. K. FERGUSON COMPANY

ENGINEERS AND BUILDERS

Headquarters: Ferguson Building, Cleveland, Ohio

District Offices: New York, Houston, Chicago, Los Angeles, Cincinnati

INVESTIGATE THE FERGUSON FIRST TEAM METHOD OF COOPERATIVE EFFORT

More BOOKSHELF

Begins on page 214

designer. Electrical transients of an overvoltage nature are stressed.

Piping Stress Calculations Simplified *(4th printing, 1951). By S W Spielvogel, mechanical engrg dept, Consolidated Edison Co of N.Y. 114 pp,. illust, charts, tables, 8½x11, $4.50. S W Spielvogel, 15 Old Field Lane, Lake Success, N.Y.*

Well-known analysis of piping calculations has been revised by addition of 21 tables. These permit fast solution of one-, two- and three-dimensional common pipe shapes. Also contains method for calculating deflections and a simplified, time-saving procedure for tabulating calculations.

Exact solutions worked out with arithmetic are retained. Piping designers who figure systems during design will find this an excellent aid in their work.

Advanced Fluid Dynamics and Fluid Machinery. *By R C Binder, Professor of Mechanical Engineering, Purdue University. 426 pp, 8½x5½, illust, $8. Prentice-Hall, Inc, 70 Fifth Ave, New York 11, N.Y.*

Despite the word "advanced" in the title this book makes a contribution to relating practical fluid machinery and theory for the student just entering the field. Written in a clear style that interprets most of the equations discussed. There are three parts (1) fluid dynamics (2) fluid machinery (3) engineering fluid dynamics.

In addition to introducing the topic of fluid mechanics or dynamics, part 1 also discusses one-dimensional compressible flow, flow with friction and heat transfer and boundary layer flow. In fluid machinery, practical equipment is described showing how theory contributes to its design. The final part deals with more complicated flows than those covered in the initial part.

Mineral Wool Insulation Specifications & Standards *(1951). 6x9, illust, flexible binding. $3.20. Industrial Mineral Wool Institute, 441 Lexington Ave, New York 17, N. Y.*

This handbook contains 21 specifications and standards by four government agencies and the American Society for Testing Materials. Insulation specifiers, contractors and power engineers dealing with insulation will find it a valuable guide to mineral-wool products, their installation and performance.

Covers almost every phase of industrial use of mineral-wool insulation—product types, characteristics, construction, selection, standard dimensions, temperature limits, thicknesses, auxiliary materials, application techniques and testing methods.

The handbook is a practical library based on thorough research, testing and on-the-job experience with mineral wool.

Automatic Feedback Control. *(1951). By W R Ahrendt, president of Ahrendt Instrument Co, and J F Taplin, president of Kendall Control Corp. 412 pp, 6½x9½, $7.50. McGraw-Hill Book Co. 330 W 42nd St, New York 18, N. Y.*

The power engineer deals with the prim-

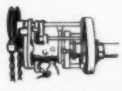
Natural Graphite licks

lubricating jobs!

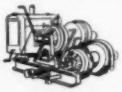
FOR EXAMPLE:

OPEN GEARS
rough treatment

CONVEYORS
moisture, corrosion


SOOT BLOWERS
high temperature

BUCKETS
exposure to weather


HOISTS
dirt, shock loads

DUST COLLECTORS
corrosion, dust

Yes:—for *all* equipment exposed to dirt, dust, moisture, the weather, and other tough conditions.

You know how *ordinary* greases fall down badly on many really tough lubricating jobs. But pick out your toughest of tough lubricating jobs ... outside, where there's rain, baking sun, dirt, dust. Try grease fortified with Dixon *Natural* Graphite – what a difference you'll see!

You get exceptionally effective lubrication from greases combined with Dixon Natural Graphite... *under the most adverse conditions.*

Dixon *Natural* Graphite is practically indestructible. Withstands temperature extremes and high pressures. Insoluble. Chemically inert: unaffected by acids and alkalies.

What is your toughest lubricating problem? Give us the facts ... our technical department will analyze your problem, send you specific recommendations and sample of the proper Dixon lubricant. No obligation. Write, Joseph Dixon Crucible Co., Jersey City 3, N. J.

DIXON
NATURAL GRAPHITE

S-E-Co. Coal Scales Fit in Small Spaces

S-E-Co. Coal Scales are designed with the idea of making them fit into the very minimum of space. For example, the overall height of the 200 pound **S-E-Co.** Scale, rated at 10 tons per hours, is 3'-9". The overall width and the overall length are also small.

Small external size does not mean small light parts, but rather it means that **S-E-Co.** Coal Scales have been very carefully and compactly designed. They incorporate large size shafts, bearings, gears and structural parts and house these parts in bodies which allow easy maintenance and still offer minimum external dimensions.

The **S-E-Co.** Coal Valve has been designed to cooperate with the **S-E-Co.** Coal Scale in order to give a total low overall height.

If you are faced with a problem of fitting a coal scale and coal valve into a plant arrangement that provides but little space for this equipment, the **S-E-Co.** Coal Scale is the machine for you.

SEND YOUR INQUIRY TO **STOCK EQUIPMENT COMPANY**

715 P HANNA BUILDING • CLEVELAND 15, OHIO

HOW TO PUT THE
"Freeze" on
Pressure Reducing
Problems...
USE
MASONEILAN
Regulators

Production and maintenance men can count on Masoneilan Pressure Reducing Valves to give accurate control of steam, water or air. Quality constructed of high grade materials they give long-lived service . . . require minimum of maintenance because they are *built up to the job* not down to price.

No. 33 for steam or air service—sizes from ⅛" to ¾". Reduced pressure ranges 2-20; 20-40; 40-100 psi. Maximum working pressure 200 lbs.

No. 227 for water service — sizes ¼" to 2". Reduced pressure ranges 10 to 60 psi. Maximum working pressure 150 psi. Also available for air service from ¼" to 1".

MASONEILAN

Your local Mason-Neilan Industrial Distributor is Ready to serve you from stock; or Write—

Mason-Neilan Regulator Company
1186 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago St. Louis • Philadelphia • Houston • Denver • Pittsburgh • Cleveland • Cincinnati • Tulsa Atlanta • Los Angeles • San Francisco • Salt Lake City • El Paso • Boise • Albuquerque Detroit • Charlotte • Appleton • Corpus Christi • New Orleans
Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

More BOOKSHELF

Begins on page 214

ciples of feedback control in his everyday work, often without realizing it. Feedback control is an operation that changes a machine's output in the presence of some outside influence. For instance, the simple thermostat regulating the factory heating plant. Here the desired temperature is introduced into the feedback control system by adjusting the pointer on a dial to correspond with the temperature wanted.

The two parts are: (1) thorough discussion of the theory of automatic control (2) detailed treatment of types of problems met in each industry; for instance, servomechanisms, speed governors, temperature, pressure, flow and liquid level controls.

Although a considerable section of the book presents a mathematical discussion there is sufficient practical information to warrant inclusion in the purely practical engineer's library.

Molesworth's Handbook of Engineering Formulae *(1951—34th edition). Edited by Albert P Thurston. 1672 pp, 4x6½ in., illust, cloth. $6.50. Macmillan Co, Importations Dept, 60 Fifth Ave, New York 11, N. Y.*

This English handbook covers civil, mechanical and electrical engineering. Standard British practice is comprehensively discussed. In many instances reference is made to American practices in the same field.

Structures and bridges, concrete and reinforced concrete, soil mechanics, hydraulics, water supply, sanitary engineering, steam engineering, power transmission, journals and bearings, fuel, heating, air conditioning and ventilation, refrigeration, motors, transformers, illumination and protection against lightning are covered.

American engineers working in England or British possessions will find this book valuable because it includes many British standards. These are often difficult to obtain in a hurry elsewhere.

More FREE BULLETINS

Begins on page 171

nous roofs and metal. Specifications, application data, approximate costs and equipment for applying. 4-page bulletin. American Bitumuls & Asphalt Co, 200 Bush St, San Francisco 4, Calif.

MATERIALS HANDLING

B32 **COST-CUTTING METHOD** — Types of handling tools, plan for analyzing handling methods with charts and summary sheets. 24-page bulletin No. P-902 Rev. Yale & Towne Mfg Co, 11000 Roosevelt Blvd, Philadelphia 15, Pa.

B33 **TRUCK CATALOG**—Specifications and illustrations for hand and trailer trucks, baggage wagons, platform skids, dollies, lift jack systems, etc. 12-page catalog No 508-B. The Howe Scale Co, Rutland, Vt.

★ **ELECTRIC STAIRWAYS**—Buyer's guide. Cut-away view, discussion of parts, available sizes, price data, layouts. 32-page booklet B-4582. Write direct, not to POWER, on company letterhead. E B Dawson, Dept T, Elevator Div, Westinghouse Electric Corp, Jersey City, N. J.

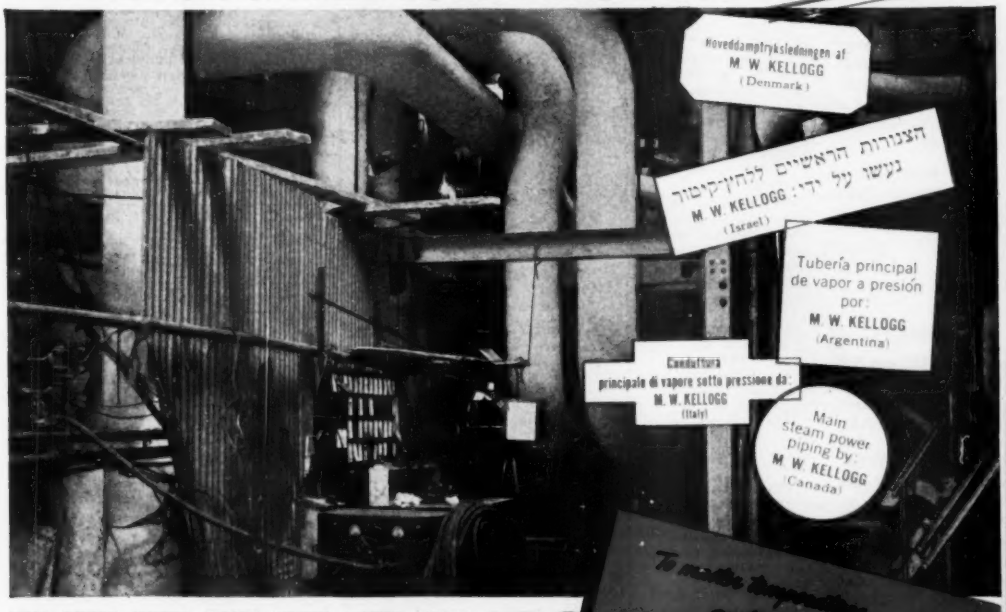
(Continued on page 220)

Note: it's an International "spec" now!

. . . fifteen new 50,000 kw. or larger turbines scheduled for seven countries outside the U. S. . . . plus six smaller units for a grand total of more than a million new kilowatts of capacity—all main steam and reheat piping by Kellogg . . . all alloy piping for as high as 1000 F. In every case, Kellogg is fabricating the sub-assemblies and is also supervising the final installation. The basic reasons that "main steam piping by Kellogg" is now an International spec are found in Kellogg's many years of experience in this highly specialized field. . . . in the Kellogg installations, for more than 600,000 kws. completed since the war in these same countries . . . and in the better than 2 million kws. of alloy installations completed, or now in work, for U. S. utility company operations at temperatures as high as 1100 F.

Canalisation principale de vapeur sous pression par: M. W. KELLOGG (France)

Entubación principal de vapor a presión por: M. W. KELLOGG


Hoveddamptrykledningen af M. W. KELLOGG (Denmark)
הצנורות הראשיים להחץ-קיטור נעשו על ידי: M. W. KELLOGG (Israel)
Tubería principal de vapor a presión por: M. W. KELLOGG (Argentina)
Condutture principale di vapore sotto pressione da: M. W. KELLOGG (Italy)
Main steam power piping by: M. W. KELLOGG (Canada)

To enable temperatures, pressures and chemicals run

M. W. KELLOGG

piping and process equipment

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

KELLOGG 50th ANNIVERSARY 1901 - 1951

Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Pressure Vessels
Vacuum Vessels
Fractionating Columns
Drums and Shells
Heat Exchangers
Process Piping
Bends and Headers
Giant One-Piece Bends
Forged and Welded Fittings
Radial Brick Chimneys

★

The M. W. Kellogg Company, (A Subsidiary of Pullman Incorporated) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

OIL AND GAS BURNING EQUIPMENT FOR EVERY INDUSTRIAL APPLICATION

Whether you burn pitch, tar, oil, gas or a combination of these fuels, there's a NATIONAL AIROIL BURNER for your job.

Our more than 38 years' experience in the design, development and manufacture of all types of industrial burners is at your service.

Ask us about your requirements . . . we'll gladly give you full information.

PRODUCTS

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes; STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.

TYPE "SA"
(For use where steam is available) *atomizes thoroughly* and *burns completely*, the lowest and cheapest grades of fuel oil and tar, requiring only low oil pressure and temperatures. Send for Bulletin No. 21.

TYPE "S-A-L"
(Large capacity burner similar to TYPE "S-A-R") is adaptable in combination with powdered coal burners in large boilers. Send for Bulletin No. 24.

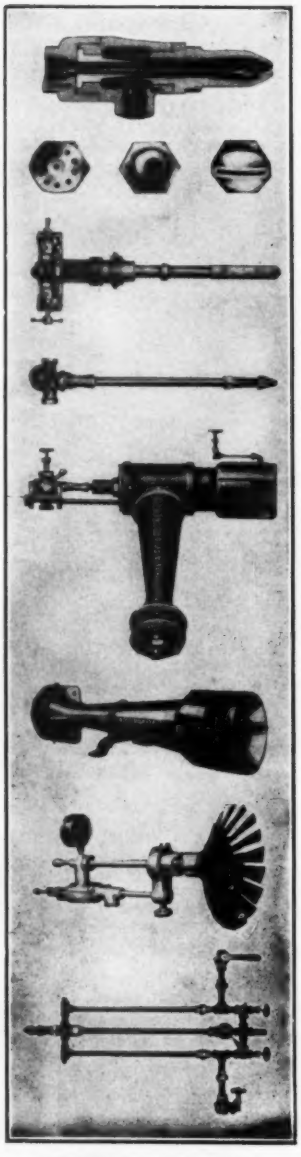
TYPE "S-A-R"
(Where steam, or gas is available for atomizing) safely and efficiently burns residuums obtained from process. Send for Bulletin No. 23.

COMBINATION GAS AND OIL BURNER
— the "AIROCOOL" Gas Burner in combination with a TYPE "S-A-R" Oil Burner. Send for "AIROCOOL" Brochure.

"AIROCOOL" GAS BURNER
(Of venturi type), assures low turndown without burnback. Send for "AIROCOOL" Brochure.

MECHANICAL PRESSURE ATOMIZING OIL BURNERS
with multi-vane type air diffuser to give a positive swirl to entering combustion air. Send for Bulletin No. 13.

TYPE "S-A-D"
(Refuse Oil Burner) burns acids or caustic oils, sludges, asphalts, tank bottoms, polymer oils, heavy petrolatum, organic oil residuums, waste cutting oils, sulphite pulp liquors, tars, pitches, etc., in combination with fuel oil. Send for Bulletin No. 21.



NATIONAL AIROIL BURNER CO., INC.
Main office & Factory: 1250 EAST SEDGLEY AVENUE
PHILADELPHIA 34, PA.
SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD
HOUSTON 6, TEXAS

More FREE BULLETINS

Begins on page 171

B35 **HOSPITAL ELEVATOR**—Discussion of problems and solutions with different types and arrangements of elevators and dumb-waiters. 20-page bulletin. Otis Elevator Co, 260 Eleventh Ave, New York 1, N. Y.

METALS AND ALLOYS

B36 **STAMPINGS**—Methods of production and plant facilities described. Information to assist purchasers in preparing specifications. 12-page booklet. Stampings Div, Laminated Shim Co, 85 Union St, Glenbrook, Conn.

B37 **CORROSION - RESISTANT ALLOYS**—Physical and chemical properties, corrosion-erosion-resistance and cavitation-pitting data. Working characteristics. Applications include centrifugal pumps, plug valves, pipe, tube, fittings. Charts, photos. 20-page bulletin No. PI-3. Ampco Metal, Inc, 1745 S 38th St, Milwaukee 46, Wis.

B38 **STANDARD STEEL BARS**—11x16½ in. wall chart gives machining data on 275 grades of standard, special and alloy steels. Arranged according to AISI Nos. LaSalle Steel Co, Chicago 80, Ill.

B39 **BRASS AND COPPER ALLOYS**—4-page folder lists 65 commonly used copper-base alloys, with their composition, properties, forms and typical uses. Bridgeport Brass Co, 30 Grand St, Bridgeport 2, Conn.

B40 **NICKEL-ALLOY CAST IRONS**—*NiResist* metals withstand corrosion, heat, wear, and low temperature. 36-page bulletin gives applications, service data, properties, corrosion data on nearly 400 conditions. Photos, charts. International Nickel Co, Inc, Dept EZ, New York 5, N. Y.

METERS AND INSTRUMENTS

B41 **THERMOCOUPLE AND PYROMETER SUPPLIES** — 56-page combination catalog and handbook. No. P1238, gives specifications, illustrations, prices, calibration data. The Bristol Co, PO Box 1790, Waterbury 20, Conn.

B42 **OPTICAL STRAIGHTEDGE** — Measures surface flatness with reference beam of light. 3 1/3 to 13 ft long. Photos. 4-page catalog No. 20. F T Griswold Mfg Co, W Lancaster Ave, Wayne, Pa.

B43 **LIQUID LEVEL GAGE**—Remote reading type. Works on hydrostatic heads, indicates up to 100 in. of level variation. 8-page bulletin No. 176. Operating principle, photos, dimensions. Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

B44 **SCALES AND DYNAMOMETERS**—Standard, quick-stop, traction dynamometers, push - pull gauges, straight spring, platform scales. Spring testers. 8-page bulletin pictures Chatillon line of instruments. John Chatillon & Sons, 85 Cliff St, New York 38, N.Y.

B45 **THERMOCOUPLE WELLS** — Straight and tapered. Prices, technical data, charts, curves, photos, dimensions. 28-page catalog No. 200-1. Minneapolis-Honeywell Regulator Co, Brown Instrument Div, Station 40, Wayne and Windrim Ave, Philadelphia 44, Pa.

B46 **DAYLIGHT ILLUMINOMETER**—Continuously records daylight intensity in footcandles. Photocell is essentially independent of temperature changes. 2-page bulletin No. ND46-72(1). Photos, dimensions, specifications. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

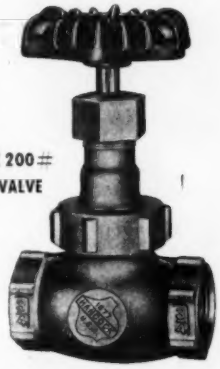
B47 **PYROMETER SUPPLIES** — 44-page catalog No. 100-4. Components, replacements, base metal, noble metal and special purpose thermocouples. Complete catalog information. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne and Windrim Ave, Philadelphia 44, Pa.

B48 **INDICATING PYROMETERS AND RESISTANCE THERMOMETERS**—Use plug-in galvanometer unit and 2-compartment case. Scale ranges to 3200 F. Wiring diagrams,

Introducing our new "baby"

THE HANCOCK 200# BRONZE VALVE

with "500 Brinell" Stainless Steel Seat and Disc



Globe and Angle Types, Screwed Ends
Sizes: ¼" thru 2"
Pressures up to 200#, 500°F.
Non-Shock Cold Water, Oil or Gas, 400#

Usual Bronze Valve Diaphragm Construction

Hancock Bronze Valve Diaphragm Construction
125% to 230% STRONGER

Designed for durability . . . made with precision—here is the latest addition to the 74-year-old family of Hancock Valves. This new 200# valve gives you every premium design feature found in other Hancock Bronze Valves:

"500 Brinell" Stainless Steel Plug Seat and Disc. A Hancock "first." Nearly diamond hard—honed to mirror-like finish. No wire drawing, steam cutting, erosion or corrosion. Not affected by boiler scale, pipe turnings or other foreign matter. No leaks. Maintenance minimized.

125% to 230% Stronger Diaphragm Construction than ordinary bronze valves. Strains of installation and piping, expansions in piping systems can't harm it.

Hard-Rolled Bronze Stem. Tough, high tensile strength metal that can take the roughest treatment.

Real Back Seating for Packing Under Pressure. Direct seat between stem and bonnet—away from heat and flow of pressure media.

Long-Wearing, Tight-Sealing Packing. High-quality asbestos lubricated with graphite.

Cool, Comfortable Handwheel. Basket-type. Reinforced malleable iron. Built to operator specifications.

Before you specify bronze valves, check Hancocks against those of any other make. For greatest efficiency, longest service, biggest savings—*you'll choose Hancock*. Remember, they cost no more than ordinary valves.

Your nearby Hancock distributor will handle your valve needs promptly. Ask him about this new 200# bronze valve.

When Hancocks go in, valve costs go down

HANCOCK VALVES

A product of MANNING, MAXWELL & MOORE, INC. WATERTOWN 72, MASSACHUSETTS

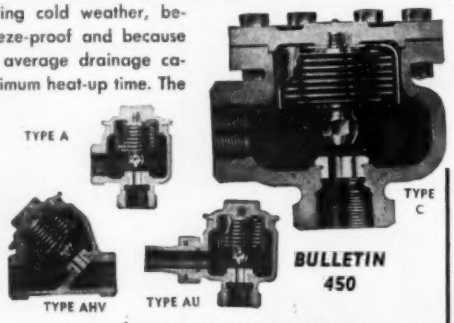
MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

NICHOLSON MAKES

Freeze-Proof Steam Traps

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non - air - binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Size ¼" to 2" pressures to 225 lbs.



BULLETIN 450

125 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

HENSZEY *Boiler Feed* REGULATOR

Keeps a WATCHFUL EYE *on* BOILER WATER LEVELS

• CONTINUOUSLY • AUTOMATICALLY • ACCURATELY

under ALL LOAD CONDITIONS

They help avoid the hazards of high, as well as low, water levels. They function night and day—once installed and set for operation no attention is necessary — nothing to get out of order — nothing to rust.

A simple, compact unit — installs right in the line — no additional supports are necessary. Pressures up to 600 lbs., sizes up to 4 in.

For details consult Sweet's Catalog or write:

HENSZEY COMPANY

DEPT. D12, WATERTOWN, WISCONSIN

HENSZEY

BOILER FEED REGULATOR

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

More FREE BULLETINS

Begins on page 171

circuit information, dimensions. 8-page bulletin No. 1051. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne and Windrim Ave, Philadelphia 44, Pa.

PIPING, VALVES, FITTINGS AND SPECIALTIES

B49 **DIAPHRAGM CONTROL VALVES**—Also liquid-level controllers, pressure controllers, safety heads, welded steel tanks, walkways. 20-page bulletin *BS&B in the Process Industries* gives specifications, dimensions, photos. Black, Sivalls and Bryson, Inc, Public Relations Dept, 7500 E 12th St, Kansas City 3, Mo.

B50 **HYDRAULIC VALVES**—Up to 1500 psi; hand, foot, cam, solenoid, oil pressure or air pressure operated. ⅛ to 1½ in. sizes. 28-page catalog No. 203 lists 138 different models. Drawings, specifications. Rivett Lathe & Grinder, Inc, Brighton 35, Boston, Mass.

B51 **TUBE FITTINGS** — *Swagelock* leakproof line. Available in brass, aluminum, steel, stainless steel and monel. 12-page catalog No. B-151. Photos, dimensions, installation recommendations. Crawford Fitting Co, 884 E 140th St, Cleveland 10, Ohio.

B52 **COMPRESSION PIPE COUPLINGS**—For ⅛ to 14 in. pipe and tubing sizes. Joins threaded or non-threaded pieces. 4-page bulletin. Morris Coupling & Clamp Co, PO Box 632, Ellwood City, Pa.

B53 **BOILER SERVICE VALVES**—For surface blow, bottom blow-off, water-column blow-off. Quick- and slow-opening types. Photos, diagrams, dimensions. 24-page bulletin No. E 125. Everlasting Valve Co, Dept 42, 49 Fisk St, Jersey City 5, N.J.

B54 **SILENT CHECK VALVES** — Prevent water hammer and pressure surges in pipe. Standard sizes from 1 to 20 in., pressures to 600 lbs. 4-page bulletin No. WH-100. Williams Gauge Co, 1620 Pennsylvania Ave, Pittsburgh 33, Pa.

B55 **FLOAT VALVES** — For water supply pressures to 100 lbs. Capacity to almost 1500 gal per hr. 2-page bulletin No. L-100. Photos, performance curves, dimensions. McDonnell & Miller, Inc, 3500 N Spaulding Ave, Chicago 18, Ill.

WATER TREATMENT

B56 **WATER CONDITIONERS**—Demineralizers, degasifiers, filters. Types and operation. 4-page bulletin. E H Clohessy, Gen Mgr, Penfield Mfg Co, Inc, 19 High School Ave, Meriden, Conn.

WELDING

B57 **LOW-TEMPERATURE WELDING ALLOYS** — Discussion of welding problems, procedures, with data sheets. Over 100 pages *1951 File of Defense and Maintenance Conservation Welding Problems*. Dept P, Eutectic Welding Alloys Corp, Flushing, N.Y.

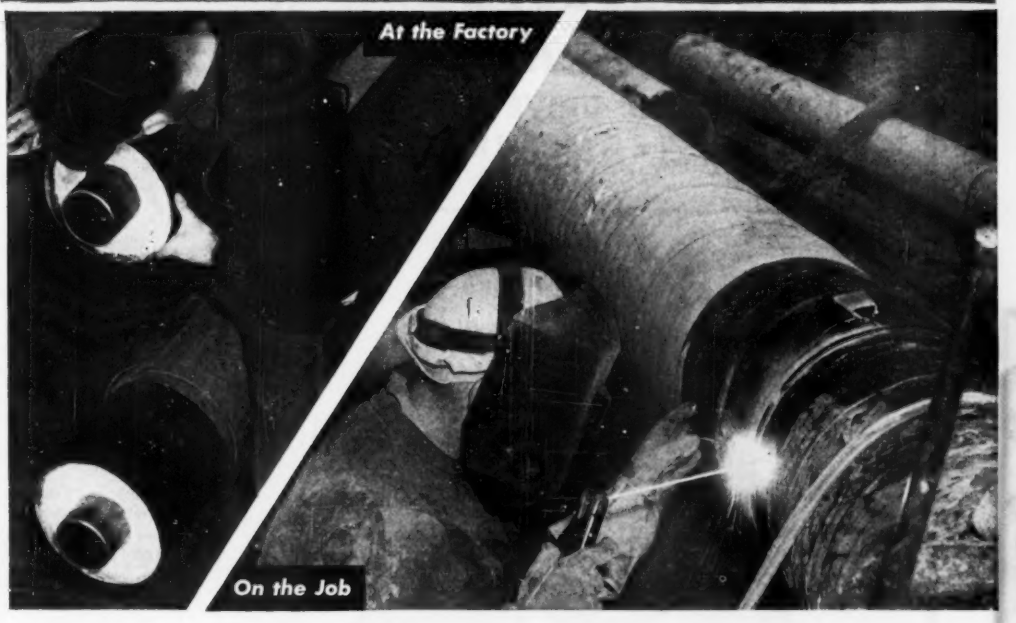
B58 **CABLE CONNECTIONS**—Illustrated catalog of complete line with information on care and maintenance of electric welding cables and connections. 12-page catalog No. 8. Tweco Products Co, PO Box 666, Wichita, Kans.

B59 **FUSION WELDING** — For nickel and high-nickel alloys. Technical coverage of gas and electric arc welding with instructions, tables of properties. 44-page bulletin No. T-2. Technical Service Section, The International Nickel Co, 67 Wall St, New York 5, N.Y.

B60 **WELDING MANUAL** — Engineering and design methods, data charts, catalog of *Eutectic* welding rod alloys. Illustrations. 44-page Eutectic National Defense Series No. 1. Technical Information Service, Eutectic Welding Alloys Corp, New York 13, N. Y.

RIC-WIL GIVES YOU

Sealed-in PROTECTION



FOR YOUR INSULATED PIPING SYSTEMS

Whether your insulated piping carries steam, hot water, oil, or process liquids, it is given maximum sealed-in protection and efficiency by Ric-wiL Prefabricated Units.

In Ric-wiL HEL-COR Units the piping is insulated with the most efficient material to fit its specific thermal requirements. Both pipe and insulation are housed in a protective 16-gauge helically corrugated ingot iron conduit, hot-dipped galvanized. The outside is given a heavy coating of high-temperature asphalt and is tension-wrapped with asphalt-saturated asbestos felt. The inside is protected with multicoat, baked-on type Phenolic Resin.

The ends of HEL-COR units are sealed at the factory with a heavy ring of insulating cement and special water-repellent packing to give full protection during shipping and installation.

All prefabrication is done in modern factories by skilled workers, using only the finest known protective and insulating materials.

Simple, quick "on the job" field connections may be full-welded and the entire system air-tested for tightness, providing sealed-in protection for long and efficient service.

The Ric-wiL representative nearest you will be glad to show all the advantages of Ric-wiL Prefabricated Piping as applied to your insulated piping problem.

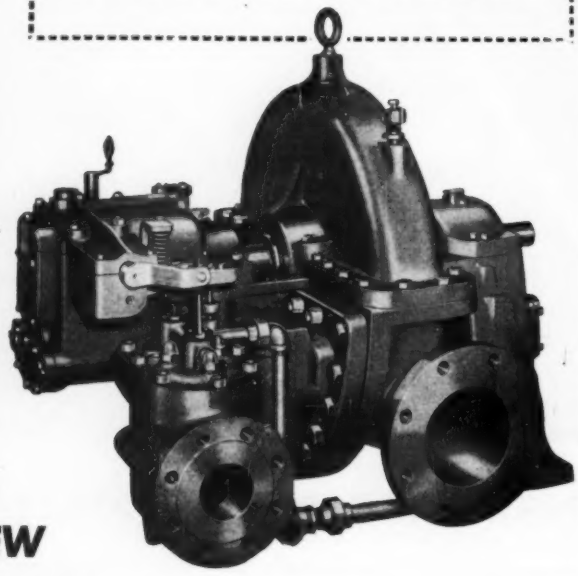
RIC-WIL
INSULATED PIPING SYSTEMS

For full technical information on Ric-wiL Insulated Piping Systems, call or write the Ric-wiL office nearest you or Dept. 8-MA in Cleveland, Ohio.

OVERHEAD — THE RIC-WIL COMPANY • CLEVELAND, O. — UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

NEW!
MURRAY
TYPE H
MECHANICAL DRIVE SINGLE STAGE STEAM TURBINE



NEW

FEATURES

- Enclosed 'shaft-through' governor
- Fast acting hand speed changer
- Improved spark proof emergency stop
- New convenient hand valve position
- Easily removed governor valve and seat
- Removable perforated metal steam strainer
- Large bearing oil reservoirs
- Large finned-tube oil coolers
- Magnetic oil-drain plugs
- New type split oil rings
- Corrosion resistant carbon packing cases
- Chrome plated shaft under carbon rings

Combining a host of new improvements plus time tested features, the Murray Type H offers extra-value in a medium size machine. With a range of 50-200 H.P., depending upon speed and steam conditions, it is offered with either a 16 or 20" diameter wheel. 3" or 4" steam inlet sizes available. Steam conditions up to 600#, 750° and back pressures up to 150# can be used.

Write today for full details.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

More POWER NEWS

Begins on page 156

products and services necessary for maintenance. This is already more than last year when something like 175 companies exhibited.

Both conference sessions and exhibits will stress value of preventive maintenance. With trend to machines that are more and more complex and higher use of electrical drive per unit worker, proportion of hand labor to mechanical is dropping fast. Shutdowns and delays from failure of equipment or controls is more costly. So role of the preventive-maintenance man takes on greater importance.

Utilities Installing Forced Circulation Units

Eighteen large high-pressure steam generating units of the controlled-circulation type for nine central stations are now building or on order in this country. These units, all ordered from Combustion Engineering-Superheater, Inc, within the last 15 months, range in rated output from 750,000 to 1,450,000 lb of steam per hr (100,000 to 200,000 kw) and in design pressures from 1670 to 2650 psig. All employ reheat of 1000 or 1050 F and initial steam temperatures run from 1000 to 1100 F. Each unit will serve a single turbine-generator.

Other units have been built, and are building, for the Navy, but little can be said concerning them at present.

The following is a list of some of the utilities ordering controlled-circulation steam generators: Virginia Electric & Power Co, Duke Power Co, Wisconsin Electric Power Co, Southern California Edison Co, Cleveland Electric Illuminating Co, Public Service Electric & Gas Co (New Jersey), Philadelphia Electric Co, Consumers Power Co.

Commission to Enlarge Niagara Project

Installation of a seventh 100,000-hp unit at new Niagara power project of Ontario Hydro-Electric Power Commission will provide still further protection for HEPC customers. Chairman Robert H Saunders said the added unit would increase total capacity of the Sir Adam Beck-Niagara Generating Station No. 2 from 600,000 to 700,000 hp when the plant is completed in 1955.

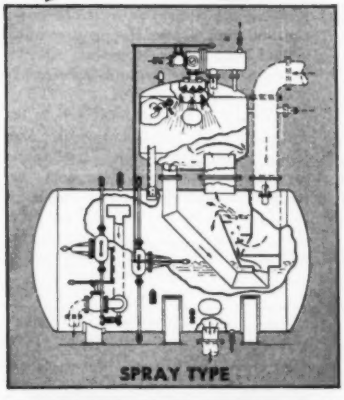
Power demands of the heavily industrialized sections of southern Ontario since outbreak of the Korean War have been as high as five times normal load growth. This abnormally high demand is expected to continue and by 1955 to exceed the 1945 power requirement by an estimated 107%.

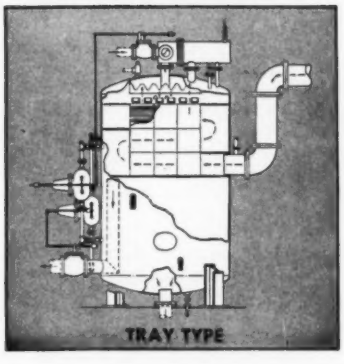
Such increases are taxing, and will continue to tax, the Commission's resources to the full, so water-power resources must be developed to the greatest extent. Apart from the St. Lawrence, the Niagara River is the only remaining major source of hydroelectric power in this province.

APPOINTMENTS begin page 234.

Writes this user of a
Graver Deaerating Heater...

> With 100% make-up water, your unit produces zero oxygen, and this office and the owners are very well pleased with the performance of the unit.





Here is part of a letter which we recently received from a midwestern engineering firm concerning the performance of a Graver Deaerating Heater installation at a large public institution of which they were in charge.

This spontaneous testimonial is typical of the reports we continuously receive from users of Graver Deaerating Heaters. Whether the units are Spray or Tray type . . . operating on steady or fluctuating loads . . . or with small or large amount of boiler feed make-up . . . a Graver installation can be depended upon to produce zero oxygen and to eliminate carbon dioxide.

Graver's 40 years of experience and pioneering leadership in water conditioning are at your service to solve your water treating problem. Whatever your needs may be, you can be sure of modern, highly effective equipment based on the latest proven developments in water conditioning processes. Your request for authoritative advice and complete information will not involve the slightest obligation on your part.

GRAVER

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

GW-438

216 WEST 14th STREET, NEW YORK 11, N. Y. • CHICAGO • PHILADELPHIA • CLEVELAND

ALLPAX
GASKET CUTTERS

ALSO:

Packing for all services; Valve Discs; Retainer Packing; Molded or Mandrel Cut Packing Rings; Packing Hooks.

Send for:

Illustrated catalog covering the complete ALLPAX line. Consult nearest distributor for your requirements.

Any shapes, cut from any materials . . . quickly, easily and accurately

This tool can prove invaluable to you—as a time and labor-saver, enabling you to cut your gaskets as you need them without wasting time or material. These precision tools quickly pay for themselves.

New Improved ALLPAX Cutter—Priced at $26.00, cuts holes from ¼" to 48" in such materials as felt, rubber, cork, asbestos sheet, etc.

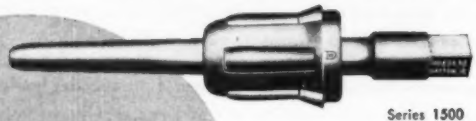
ALLPAX JUNIOR Cutter—Priced at $7.50—cuts ¼" to 6" round, oval, square, or irregular shapes. All prices f.o.b. factory.

THE ALLPAX COMPANY INC.
805 Mamaroneck Ave., Mamaroneck, N.Y.

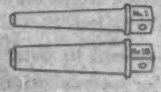
IDEAL

You'll Get More Efficiency with

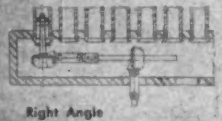
Series 1500 Tube Expanders



Series 1500



Short Mandrels



Right Angle Gear Drive

For installation and maintenance of tubes in drums, headers and similar water tube boilers.

A combination of short mandrels and right angle gear drive speeds up operation and assures efficiency with far less operator-fatigue. The new and smaller reinforced gear drive enters most hand-holes.

See Your Dealer or Write Us Today!

THE GUSTAV **WIEDEKE** COMPANY
DAYTON 1, OHIO

More TECHNICAL BRIEFS

Begins on page 158

tems has been along two lines: (1) improved system engineering (2) improved equipment for the system.

In field of system engineering, most notable advances have been introduction of load-center distribution system for both high and low voltages, trend toward higher voltages, increased use of system neutral grounding, improved short-circuit protection, etc. Load center system serves each load area by its own substation or substations. Power is taken to load center at higher voltage and there stepped down to utilization voltage. The smaller substations for utilization areas cut cost of substation and switchgear. Many steel mills now use 11.5 or 13.8 kv instead of 6.9 kv where power is transmitted in substantial quantities and for relatively long distances. In larger mills, 22, 34.5, or 69 kv are used for basic transmission from source point to load centers. Short-circuit protection, particularly in low-voltage systems, now receives more consideration. Grounding neutral of all system voltages shows marked increase in service reliability and decrease in system maintenance costs.

Equipment modifications include improvements in metalclad switchgear, factory-assembled unit substations, metal-enclosed plug-in bus duct, improved low-voltage circuit breakers, switches, fuses, etc. There are brief descriptions of these units and how they fit into the modern system. *AISE paper. No number.*

Directions for ordering papers on p 160

Control of Demand and Power Factor on Electric-Arc Furnaces. *By H G Heath, Pittsburgh Lectromelt Furnace Corp.*

Control of demand and power factor for electric-arc furnace has been a pertinent problem since 1920. A number of devices were applied to the problem, each with disadvantages. Control of demand and power factor, with differences in power rates, necessitate specific consideration of each furnace installation.

Aside from desired production rate, demand must be considered to obtain most economical power billing. Power factor of 85% indicates total impedance of 52½% in primary circuit. From record of many, many furnace installations, relation of total impedance to power factor apparently is not well understood.

Some devices for efficient operation work on impulse basis from contact-equipped watt-hour meter, and reduce load in case demand setting is ex-

IN ALL INDUSTRIES

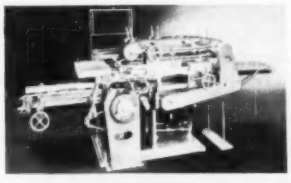
LUBRIPLATE LUBRICANTS

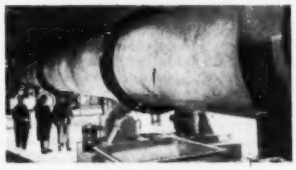
EXCEL IN REDUCING FRICTION, WEAR, UPKEEP-COSTS AND POWER CONSUMPTION... WITH BETTER MACHINE PERFORMANCE

PACKAGE MACHINERY COMPANY of Springfield, Mass., says:

"WE RECOMMEND THIS LUBRICANT TO OUR CUSTOMERS"

"We have found LUBRIPLATE Lubricants to be very effective and use them extensively in our machines. To assure the proper use of LUBRIPLATE Lubricants for re-lubrication, we place tags on our machines before shipment. Thus the purchasers of those machines know the LUBRIPLATE Product we recommend for each application and where to obtain it."





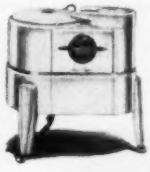
The BROWN COMPANY, Quality Paper Makers of Berlin, New Hampshire, says:

"THIS LUBRICANT SAVED US $2,098.16 IN SEVEN MONTHS"

"During the seven month period before using LUBRIPLATE No. 130AA in the bearings of our Kraft Mill Lime Kiln, we used a conventional oil of the density recommended. The cost of the lubricant for the period was $2,134.00. In the seven months that followed, we only used 128 lbs. of LUBRIPLATE No. 130AA for initial filling and replacement at a cost of $35.84. LUBRIPLATE No. 130AA only requires weekly application whereas the former lubricant required daily application."

"THIS LUBRICANT SAVES GEARS AND TRANSMISSIONS"

-says AUTOMATIC WASHER COMPANY, Newton, Iowa



"We have used LUBRIPLATE in our washing machine transmissions since 1933. Our laboratory tests as well as field experience indicate that through the use of LUBRIPLATE, we reduced the wear on the gears and prolonged the life of the transmission. The transmission is the heart of any washing machine and the long life and trouble-free performance obtained by the use of LUBRIPLATE in the Automatic Washer transmission has been an important factor in the success of our product."

F. Breckenridge
Executive Vice-President

REGARDLESS OF TYPE AND SIZE OF YOUR MACHINERY LUBRIPLATE LUBRICANTS IMPROVE OPERATION AND GREATLY REDUCE MAINTENANCE COSTS.

Write today for LUBRIPLATE Data Book No. 1-52

LUBRIPLATE DIVISION
Fiske Brothers Refining Co.
Newark 5, N. J. Toledo 5, Ohio

DEALERS FROM COAST TO COAST—SEE YOUR CLASSIFIED TELEPHONE BOOK

BIDDLE

BOOTH 510

WE'LL BE AT THE PLANT MAINTENANCE SHOW PHILA. JAN. 14-17

Instrument News

ARE YOU SURE OF PROTECTION THROUGH YOUR GROUND CONNECTIONS?

Biddle Ground Tester measures low resistance

Photo Courtesy Copperweld Co.

In spite of apparently good lightning rod or arrester protection, lightning frequently will cause severe damage if high ground resistance hampers its dissipation in the earth. Lightning storms are prevalent in the northeastern states during the spring and fall months. Plants in this section should make a thorough round of ground resistance tests. Aside from the hazards to personnel, thousands of dollars may be saved in damage to electrical equipment and in loss of power and stoppage of production.

The MEGGER® Ground Tester is the easiest, quickest and most accurate method of determining ground resistance. It is an instrument specially designed for the purpose and should be used wherever possible. Direct readings are automatically obtained in ohms. It provides its own source of current—no batteries, or other remote source required. It's easy to carry, too. Has approval of the Associated Factory Mutual Insurance Companies.

Don't put it off—write today for "Grounding Electrical Circuits Effectively" by J.R. Eaton (Bulletin 25T2-P) and our Biddle manual on "Ground Resistance Testing" (Bulletin 25J-P).

HERE'S A "GOOD COMPANIONS" KIT FOR PRACTICAL ELECTRICAL ENGINEERS AND MAINTENANCE MEN

Men concerned with all-around-the-plant electrical tests and resistance measurements tell us that these are "indispensable" tools:

Midget Megger Electrical Insulation Tester for detecting dirt, moisture and deterioration in advance of failure, or as a trouble-shooter after failures occur.

The Midget Megger Circuit Testing Ohmmeter for measuring conductor resistance of coils, contacts and relays, and checking continuity of circuit and grounded parts.

Be sure to write for your copy of our new Bulletin 21-85-P today.

JAMES G. BIDDLE CO.
1316 Arch St., Philadelphia 7, Pa.

Please mail me ☐ Bulletin 25T2-P
☐ Bulletin 25J-P ☐ Bulletin 21-85-P
Thank you.

Name _____

Job _____

Company _____

Address _____

JAMES G. BIDDLE CO., 1316 ARCH ST.
PHILADELPHIA 7, PA.

ELECTRICAL TESTING • SPEED MEASURING INSTRUMENTS • LABORATORY & SCIENTIFIC EQUIPMENT

More TECHNICAL BRIEFS

Begins on page 158

ceeded. Inherent disadvantages are (1) load might be cut too often (2) advantage might not be taken of any delay during the preiod.

Within past two years fixing demand for several furnace voltages directly as function of electrode positioning regulator has been applied. This demand value is based on efficient current value and is independent of any adjustment by furnace operator. Some modifications have been applied. Where a number of furnaces are involved in one plant, staggering load to limit maximum demand is in order. *AISE paper. No number.*

Heating and Ventilating

Heat Relief in Hot Industries. *By B R Small, Aluminum Co of America.*

Metal-producing industries profit by providing employe relief from excessively hot working conditions. Industrial ventilation now utilizes radiant-heat shielding at furnaces, local or spot air cooling and crane-cab air conditioning. Increased building ventilation is possible with fan-powered roof ventilators, either conventional round wind-band design or more convenient blackout or dome-top styles.

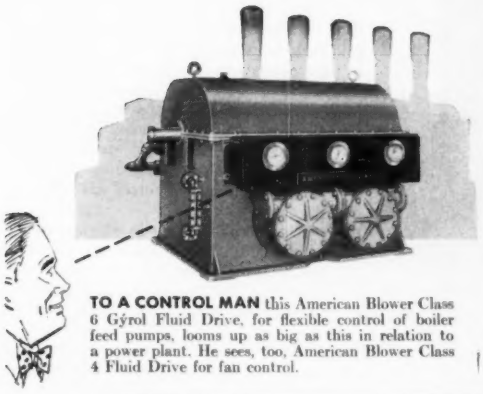
Recently developed methods of radiant-heat shielding by portable reflective sheet-metal curtains have aroused considerable enthusiasm among operating crews and supervisors. About 90% of radiant heat from a hot furnace shell or brickwork surface can be intercepted by a curtain that comes to equilibrium only 20 F above room-air temperature. The convective component is dissipated as hot air through existing roof ventilators. In certain situations startling results have been obtained at a fraction of the cost of supplementary ventilation.

For severe conditions unsuited to radiant-heat shielding, an alternate method is local or spot cooling, long used for shipboard engine and boiler rooms. This cooled air does not involve air conditioning, but merely washed air delivered from grilles at 80 or 85 F during hottest weather. It may eliminate need for increasing ventilation rate, a step of formidable proportions in a large building.

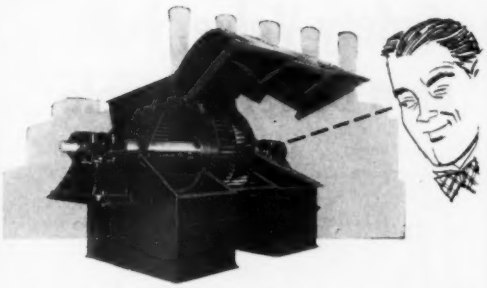
In colder climates there may be serious inadequate heating and cold drafts. These are byproducts of the summer natural-draft ventilation program with its open-type buildings. For better heating, consideration of winter as well as summer aspects frequently

Directions for ordering papers on p 160

It all depends on how you look at it

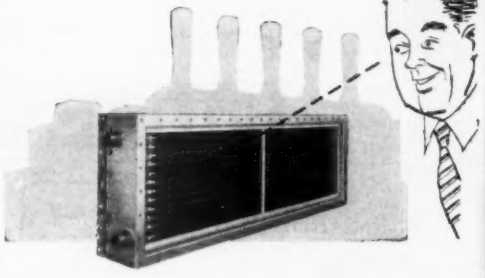


TO A CONTROL MAN this American Blower Class 6 Gyrol Fluid Drive, for flexible control of boiler feed pumps, looms up as big as this in relation to a power plant. He sees, too, American Blower Class 4 Fluid Drive for fan control.



TO A MECHANICAL DRAFT MAN a Sirocco Multi-Blade Fan, which delivers more gas per revolution than any other type, takes *this* proportion in the picture. He could see an American Blower HS Fan equally large if thinking of forced draft.

TO A FLY ASH EXPERT an American Blower Type ST Fly Ash Precipitator looks like this in relation to the rest of the power plant. Little wonder, for the Precipitator lifts a load off his shoulders and minimizes a nuisance.



TO A COIL MAN American Blower Heavy Duty Steam Coils would appear like this in his power plant picture. He likes their great strength, easy accessibility and the way they withstand the high pressures of heavy loads.

Looking at your complete power plant picture, we believe you'll find, as hundreds of others have, that all these American Blower Products improve over-all power-plant efficiency and insure years of dependable operation. Call our nearest Branch Office for complete data.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

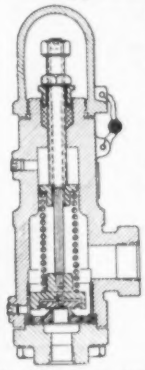
Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Now! A New Safety Valve, Built on a Better Principle

PATENT PENDING

This improved equipment has the seat and moving parts of stainless steel; no danger of rusting fast! The parts are self-aligning and accurately made. The opening is full, giving the valve much greater capacity than earlier types



New Valve has Many Advantages: see Frick Bulletin 193

The new valve can be reseated after it opens. It meets the requirements of the latest A.S.M.E. and A.S.A. B-9 Codes. Built in ½", ¾", 1" and 1¼" sizes.

Sensitive, dependable, and safe, this valve will give your refrigerating system the adequate protection you need.

Order today from your nearest Frick Branch or Distributor, or direct from

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U.S.A.

WHEN YOU'RE ASKED...
WHERE WERE YOU JAN. 14-17, 1952?
BE SURE YOU'RE ABLE TO SAY...
AT THE THIRD
PLANT MAINTENANCE SHOW & CONFERENCE
IN PHILADELPHIA

REMEMBER... this is the show for presidents, vice presidents, general managers, plant managers, plant engineers, maintenance engineers—and all other plant operating men whose responsibility it is to select, install, operate, and maintain the plant equipment and services that mean low-cost operation and high production.

SO... circle Jan. 14-17 today on your 1952 calendar ... write right now for rooms at your favorite Philadelphia hotel (for yourself and key people in your organization)... and mail this coupon →

CLAPP & POLIAK, Show Management 10
341 Madison Ave., New York 17, N. Y.
Please send ____ tickets for the Plant Maintenance Show.

NAME_____
TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

FREE

More TECHNICAL BRIEFS

Begins on page 158

favors power ventilators and easily controlled air inlets. These help secure steam saving and uniform heating.

Layouts of new or modernized plants may benefit directly from ventilating considerations in early conferences. For example, more compact building arrangement and a shorter production flow line were made possible by eliminating one line of space-wasting courtyards. New fresh-air-type roof ventilators provided forced air without ductwork.

Considerable groundwork is necessary before major projects are submitted to management, because radiation-shielding and spot-cooling procedure is still far from standardized. Further, various engineers and operating personnel have different yardsticks for measuring end results in heat relief. Again, each plant and department frequently has special conditions that must be taken into account. In spite of such road blocks, this new phase of industrial engineering can valuably contribute to plant economy and increased productivity. *AISE paper. No number.*

Lubrication

Spray Lubrication of Open Gears. *By Joseph A Rigby, The Brooks Oil Co.*

Open gears are diminishing in general use and often are supplanted with enclosed gears or direct drives in new installations. But magnitude of quantity in use, continuation of service for the future and necessity for continued use with certain types of new equipment means their lubrication will continue mighty important.

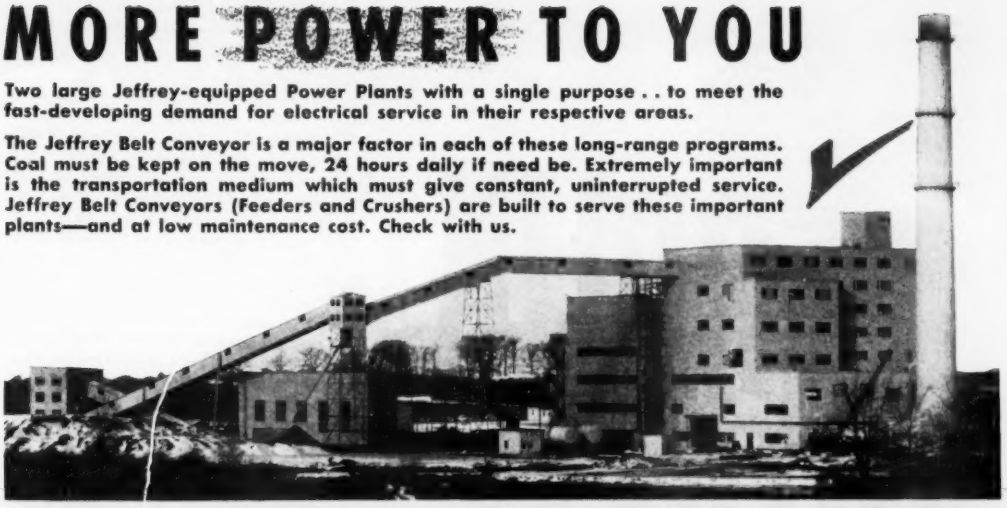
Lubricants have probably been used since the invention of metal gears. Gradual increase in loads, speeds, improvement in gear design and heavy industrial development have in turn presented a problem to lubricant manufacturers. Lubricants have gradually changed from animal and vegetable fats to compounds of the same, petroleum compounds of resinous materials, residual products, extreme-pressure greases and solvent cutback materials. Early lubricants were probably applied by swabbing with fats or dropping gobs of lubricants on gears. Dipping and dripping methods have also been used. There was then evolution to almost-solid lubricants that required heating and were applied by pouring. With this method, protection against wear was reasonably well developed. But a build-up of lubricant produced high frictional

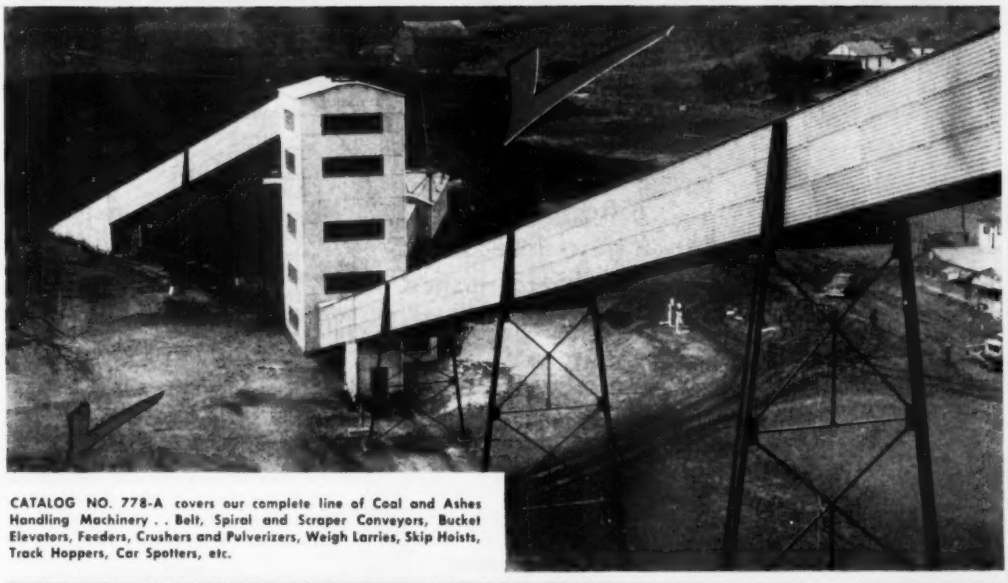
Directions for ordering papers on p 160

MORE POWER TO YOU

Two large Jeffrey-equipped Power Plants with a single purpose . . to meet the fast-developing demand for electrical service in their respective areas.

The Jeffrey Belt Conveyor is a major factor in each of these long-range programs. Coal must be kept on the move, 24 hours daily if need be. Extremely important is the transportation medium which must give constant, uninterrupted service. Jeffrey Belt Conveyors (Feeders and Crushers) are built to serve these important plants—and at low maintenance cost. Check with us.





CATALOG NO. 778-A covers our complete line of Coal and Ashes Handling Machinery . . Belt, Spiral and Scraper Conveyors, Bucket Elevators, Feeders, Crushers and Pulverizers, Weigh Larries, Skip Hoists, Track Hoppers, Car Spotters, etc.

THE JEFFREY MANUFACTURING COMPANY

ESTABLISHED 1877

982 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

Perolin
SINCE 1904

PEROLIN QUALITY

...backed by a half century of experience guarantees unexcelled service and performance

PEROLIN FUEL OIL TREATMENT
for Soot and Sludge

PEROLIN BOILER TREATMENT
for Scale and Corrosion Control

PERO-NITE
Soot and Fire Scale Remover

FORMET WATER TREATMENT
for Water Supply and Air-Conditioning Systems

PERO-KOTE TANK COATING
for Water Tanks

AND MANY OTHER MAINTENANCE PRODUCTS

The PEROLIN COMPANY, Inc.
Manufacturing Chemists since 1904
NEW YORK 16 • CHICAGO 9

Warehouse stocks in 21 conveniently located centers of the United States and Canada.
Write for name and address of nearest representative.

More TECHNICAL BRIEFS

Begins on page 158

drag, excessive throw-off and high cost clean-up.

Extreme-pressure greases and solvent cutback lubricants, with unusual adhesiveness, thin film, and extremely high film strength, met with great favor and were quickly adopted. Better methods for application are now important. This involves improved distribution on gear teeth, more economical consumption of lubricants, handling of lubricants without contamination, negligible heating requirements, reduction of throw-off and drippage, safe working conditions for workmen and progressive and aggressive action to keep up with engineering and industrial advancements.

Lubricant appliance manufacturers are developing practical equipment to successfully and economically spray open gear lubricants. These are of various types, but provide open gears with logical, safe and economical lubrication. *AISE paper. No number.*

Directions for ordering papers on p 160

Lubrication of Wire Rope. *By C H Layton, American Chain & Cable Co.*

The days are gone when manufacturers and most wire-rope users were content to apply just any available grease or lubricant to wire rope and consider the matter closed. Considerable study has been made in past years regarding value and proper type of wire-rope lubrication. Such studies may well continue as long as industry uses wire rope. The complex problem of proper lubrication is extremely interesting and its scope within manufacturer's plant is considerable.

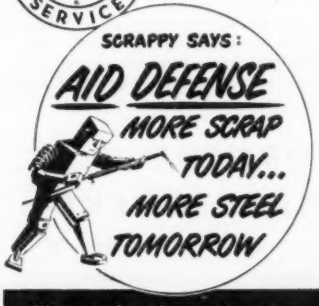
Each wire-rope manufacturer uses what, in his opinion, is most suitable for the service. For proper lubrication, whether on an old or new installation, it is first necessary to analyze existing conditions. Type of deterioration to guard against is determined by a careful survey of rope in service or a discarded sample. Always safety of men, materials and continued production depends on the wire rope.

Anyone familiar with lubrication can appreciate frictional forces set up and type of deterioration that can take place if bearing points are not properly lubricated. Wire rope must be properly treated and maintained to insure safety of operation and the ultimate in service. *AISE paper. No number.*

American Welding Society elected as president for 1951-52 Charles H Jennings, engineering mgr, welding dept, **Westinghouse Electric Corp.** He took office during the week of October 15th.

NO SCRAP... NO STEEL!

QUALITY
YOUNGSTOWN
SERVICE



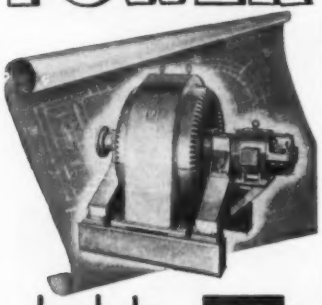
THE iron and steel industry faces a serious scrap shortage, growing more critical every day. . . . It will be impossible for producers to make the steel tonnages demanded for rearmament and essential civilian needs, unless consumers cooperate by furnishing *more scrap*. . . Most desperately needed now is heavy industrial iron and steel scrap. . . . Keep the cobwebs from gathering at your own plant by turning in more of your own scrap today.

The Youngstown Sheet and Tube Company

General Offices—Youngstown 1, Ohio
Export Offices—500 Fifth Avenue, New York
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.

for
custom-engineered
POWER



look to... EP

Since 1909, the job of The Electric Products Company has been to create and develop special electrical rotating equipment . . . motors and generators to do existing jobs better or to reach into new fields to do jobs that couldn't be done before. The natural "by-product" of our more than 40 years of specialization is that you get equipment designed and built to the exact requirements of your application . . . equipment that has greater dependability, longer life and that requires less maintenance.

Send in the coupon below for detailed information about our Custom-Engineered synchronous motors and generators . . . d-c motors and generators . . . induction motors . . . battery chargers . . . frequency changers.

A nation-wide sales engineering and service organization stands ready to meet all User requirements.

THE ELECTRIC
PRODUCTS COMPANY

1717 CLARKSTONE ROAD
CLEVELAND 12, OHIO

Attach coupon to your letterhead for your copy of Bulletin 2-200

NAME_____
TITLE_____
COMPANY_____
STREET_____
CITY_____ ZONE____ STATE_____
X-74

APPOINTMENTS

Link-Belt Co opens new factory branch store at 108 S 4th West St, Salt Lake City, under Donald W Newsome, dist mgr, assisted by Harry Hotchkiss. Bert Pearce becomes chief engineer of the Ewart plant in Indianapolis, assisted by Russell T Sweeney.

Westinghouse Electric Corp announces appointment of L R Ludwig as director of engineering and research for atomic power div, Pittsburgh; James L Brown is sales mgr for receiving tubes and cathode ray tubes at Elmira, N. Y.; Carl F Miller is new mgr of receiving tube development and design engineering at Bath, N. Y. G D Lobingier becomes mgr of new professional employment dept at Wilkinsburg, Pa.

Babcock & Wilcox Tube Co transfers J H Roach to the Houston office as asst sales mgr, and W C Mohrman to the Tulsa office as dist salesman.

Iron Fireman Mfg Co appoints George Armour mgr of NW region, headquartering in Minneapolis; C F Merrick becomes mgr of the Central region.

Jeffrey Mfg Co changes industrial sales organization as follows: Lincoln Kilbourne is new mgr of sales of conveyor div; C G Hawley is mgr of sales, products eng div; L Cole is dist mgr of Jacksonville office; Paul Lawall is mgr of sales, gen eng div in Columbus; R W Sweitzer, dist mgr of New York office; W K Myers, dist mgr in Philadelphia; Paul Hendry, dist mgr at Boston; Dan Knies and A W Lemmon become consultant sales engineers of the conveyor div in Columbus.

Superior Combustion Industries, Inc, name George A Fricke mgr of heat exchanger div, with offices in the Times Tower Bldg, New York City.

Dearborn Chemical Co adds Robert G Gerstmyer to sales staff in Charlotte, N. C.

Allis-Chalmers Mfg Co assigns Walter Winzig to the Houston dist office as water conditioning sales representative, and Al Matthiesen to Washington, D.C. office as sales representative.

Bird-Archer Co, Ltd, appoints E L Ruggles vice-president and gen mgr, with headquarters at Cobourg, Ontario.

Norton Co has two new abrasive engineers—Richard J Kervick in W. Va., and Kenneth F Ebbeson in Ark., western Tenn., Miss., and La. New director of personnel for abrasive and grinding mach divs is Frank Zacher.

General Electric Co appoints Clayton P Fisher Jr mgr of materials and purchasing for major appliance div, and transfers Lee D Nutter to New York City as mgr of major appliance sales. Francis K McCune becomes asst mgr of the engineering services div. New gen mgrs are C Howard Black

Water levels
are crystal clear with
MACBETH GAUGE GLASSES
BRAND

In steam service, you can depend on Macbeth brand gauge glasses to stay crystal-clear permanently. They resist fogging, pitting, etching and staining . . . provide maximum visibility at all times, even at a distance.

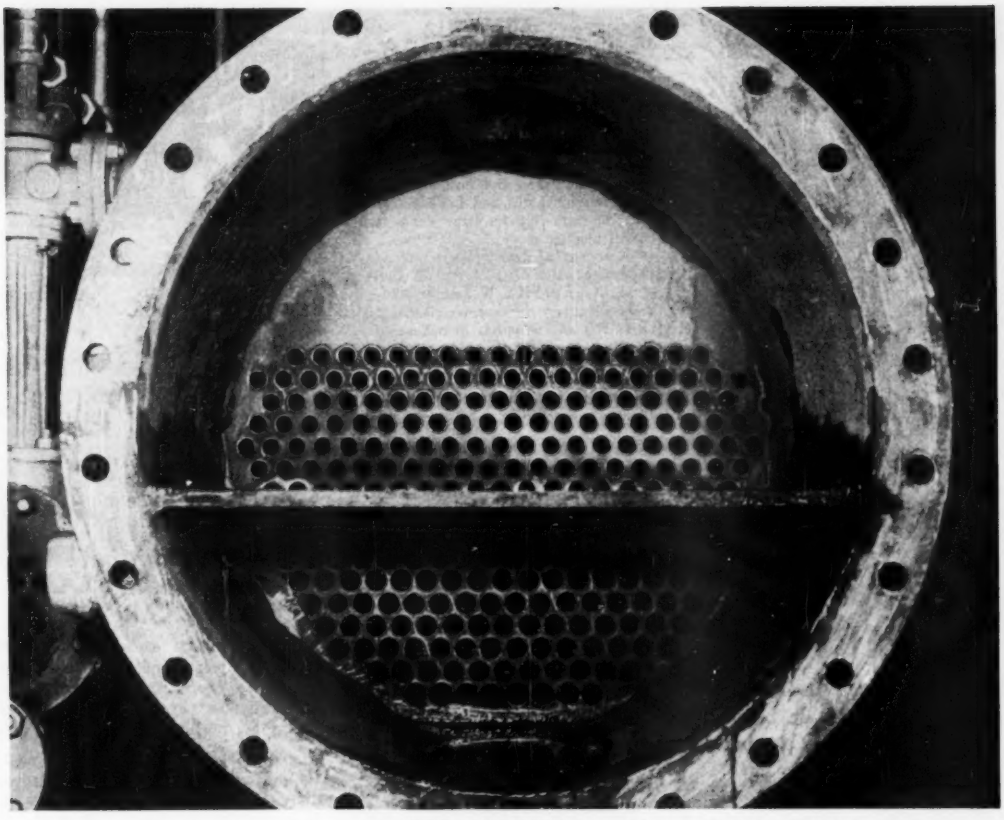
OUTLAST ALL OTHER TYPES—Shock tests show that Macbeth gauge glasses can be heated to 425°F. and then plunged into ice water . . . *without breaking!* And the extremely low coefficient of expansion of Macbeth brand glasses permits heavier construction for additional mechanical strength . . . assures longer life than any other type of gauge glass. Precision made for accurate fit and easy installation, Macbeth Gauge Glasses provide inexpensive protection for your boiler investment. Available in plain, reflex, and high pressure types through your Mill Supply Distributor.

CORNING
GLASS WORKS
CORNING, N.Y.

TM REG PYREX US PAT OFF

Gauge Glasses, Sight Glasses, Oil Cup and Lubricator Cup Glassware.

• 100 Years of Making Glass Better and More Useful •



WITH SANTOPHEN 45—This is an unretouched photo of an inter-cooler condenser, which had not been cleaned since the beginning of the Santophen 45 test in late 1949. The unit contained no slime and practically no corrosion.

Proof that Santophen 45 controls slime

Proof of the effectiveness of Santophen 45 in controlling bacterial and algal slime is established by these figures:

During 1948 and 1949, before Santophen 45 (sodium trichlorophenate, technical) was introduced, the slime problem was acute in Monsanto's 12,000-gallon-capacity air-conditioning cooling tower. To keep the system efficient, from three to five mechanical slime cleanouts were needed yearly. Cleanouts cost from $300 to $500 each.

Here are results of a definite period of observation after the introduction of Santophen 45: On July 3, 1950, Santophen 45 was added to the water at the rate of 100 parts per million. This required only 10 pounds of Santophen 45 for the 12,000-gallon system. Such applications were made biweekly until later in the fall when they were put on a weekly basis. In all, 350 pounds of Santophen 45 were used at a cost of $119. Throughout the year, the exchangers gave a high level of heat transfer and *did not require a single shutdown for mechanical cleanout.*

If you have a slime problem, get the details on Santophen 45. Your request, on business stationery, will bring you a test sample, technical data and availability information. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second St., St. Louis 4, Mo.

Santophen: Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS AND PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

Get this FREE Booklet!

YOURS for the asking—this 28-page booklet about Oakite Compound No. 32. Tells how this inhibited acidic compound quickly, safely—without dismantling—descales

- **Diesel engines**
- **Condensers**
- **Heat exchangers**
- **Compressors**
- **Dynamometers**
- **Filters**
- **Transformers**

Get your copy today! Ask your local Oakite Technical Service Representative. Or write.

OAKITE PRODUCTS, INC.
23 Thames Street, NEW YORK 6, N. Y

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

More APPOINTMENTS

Begins on page 234

of the meter and instrument dept at Lynn, Mass., Carl H Rinne of the specialty transformer and ballast dept at Fort Wayne, Ind., and Wm C Wichman of component products div. Wm L Rodich is asst gen mgr of laminated and insulating products dept, chemical div, and Louis E Newman mgr of marketing for large steam turbine and generator dept.

New mgr of product sales practice for apparatus sales div is Arthur W Bartling; H C Green and R E Wendling become dist representatives for construction materials div; F J Downs moves to Schenectady to head order service div utility section. W D Vincent has joined the Seattle, Wash, apparatus div as an application engineer; Robert T Skeer becomes mgr of major appliance sales at Seattle. Sam Littlejohn is elected commercial vice-president of the company.

Reliance Electric & Engineering Co promotes Karl H Meyer to mgr of Ivanhoe div in Cleveland; he is succeeded as mgr of the Ashtabula plant by Walter H Haber.

U. S. Rubber Co appoints Hajoca Corp a distributor of Uskon electrical radiant heating panels.

Worthington Pump and Machinery Corp promotes Thomas F Griffin to Holyoke Works purchasing agent and LeRoy D White to gen buyer of contract engineering div. J B Laramy becomes mgr of marketing research dept. W R Leopold will direct operations of the public works div, and D L Gallagher becomes mgr of that div.

Minneapolis-Honeywell Regulator Co, Brown Instrument Div, names Wm H Sisson power industry mgr, and transfers George M Rossiter to Indianapolis to become industrial mgr.

The Marley Co, Inc, moves its gen offices to 222 W Gregory Blvd, Kansas City 5, Mo, and opens engineering service office in the Wyatt Bldg, 777 Fourteenth St, N.W., Washington, D.C.; Don Cousins has been named mgr of the Washington office.

Metallizing Engineering Co, Inc appoints Julius H Nill southern regional mgr with offices at New Orleans, La.

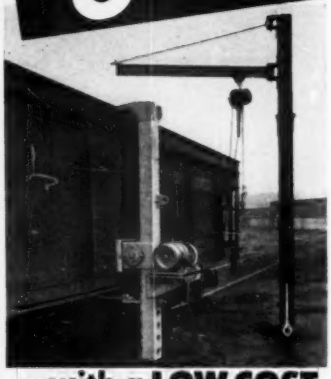
Cooper-Bessemer Corp names Edward D Van Fossen to regional field office in Seattle, Wash.

Cutler-Hammer Inc assigns A J Shradel mgr of Seattle dist sales office, succeeding T N Bristow who retires.

B F Goodrich Co promotes Emerson G Hammack to mgr of metal parts purchasing. Fred D Stinaff becomes mgr of engineering equipment purchasing.

Robert E Moyer Associates move to 10th and Union Sts, Catasauqua, Pa, location of newly acquired plant and offices of R E

UNLOAD THAT CAR IN AS LITTLE AS 6 MINUTES



...with a LOW COST NATIONAL CAR SHAKER!

Saves up to 80% on unloading costs! Cuts labor costs and keeps unloading equipment operating at full capacity. Easily handled by one man—promotes safety by keeping labor out of cars.

The National Car Shaker unloads coal, coke, cinders, sand, stone, aggregates and all bulk materials from hopper cars in a matter of minutes. Hundreds of satisfied users throughout the country.

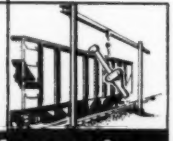
Write today for full information on how you can cut your unloading costs with a **low cost** National Car Shaker.

3 TYPES OF INSTALLATION

Wheel Cart
Shaker is easily wheeled into position and mounted on car.

Jib Crane
Permanent crane swings shaker into position on car.

Mono Rail
Shaker can be quickly moved from car to car.



National Conveyor & Supply Company

352 N. Harding Ave., Chicago 24, Ill.

NEW

SERIES 12100*

FORGED STEEL

DROP

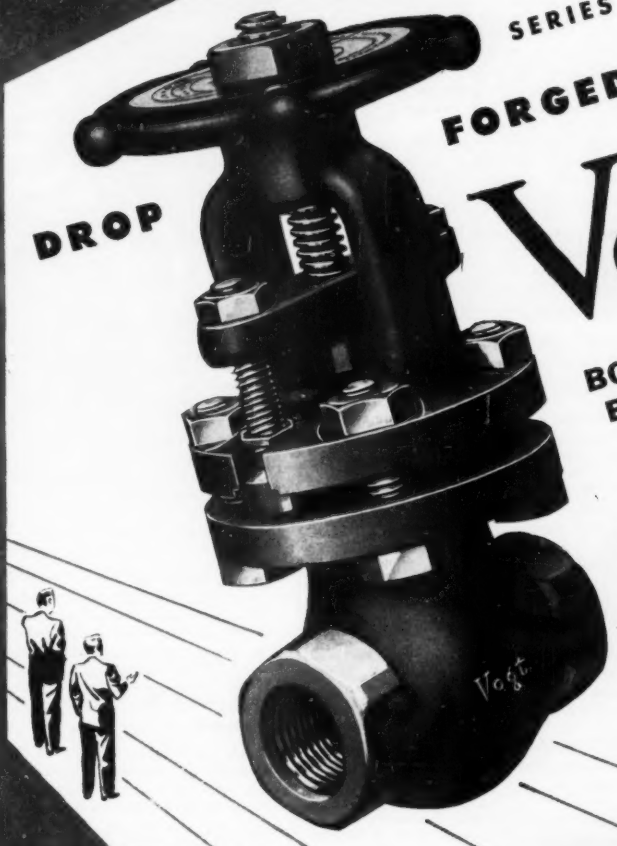
Vogt

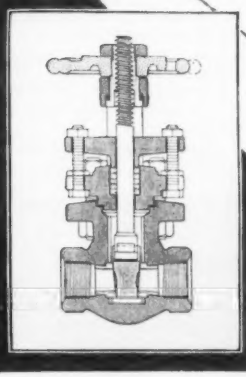
BOLTED BONNET
BOLTED GLAND

150-800 POUND

GATE VALVES

SIZES 1/4" to 2"





*Series 12100

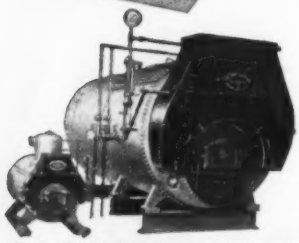
CARBON STEEL | 800 Pounds @ 750° F.
1500 Pounds Cold Non-Shock

For 150-800 pounds service • Round Bolted Bonnet • Bolted Gland • Gasket or Ground Joint • Outside Screw and Yoke • Renewable Seat Rings • Solid Wedge — Slotted Type • Rising Stem 11½-13% Chrome Stainless Steel Trimmings • Sizes 1/4" to 2" inclusive.

HENRY VOGT MACHINE CO. *Louisville 10, Ky.*

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • ST. LOUIS • DALLAS

A DOZEN
STEAM BOILER POINTERS
FROM
LEFFEL...



Check off the boiler advantages that add up to economy in your plant operation!

√ Dependable
√ Self-contained
√ Compact
√ Easily Cleaned
√ Coal, oil or gas fired
√ 6 to 250 HP (actual)
√ Designed for overload
√ Rugged construction
√ Safe
√ Lowest operating cost
√ Easily maintained
√ Maximum combustion

Leffel's generations of boiler-making experience assure you that your next boiler will be your best — if it's a Leffel.

Write for descriptive catalog

The James Leffel & Co.
Established 1862

DEPT. O SPRINGFIELD, OHIO

NO BOLTS, RIVETS, OR WELDS
WITH TRI-LOK

OPEN STEEL FLOORING

Tri-Lok open steel flooring is fabricated of cross-bars (see B above) twisted in opposite directions at each bearing bar (note arrows on A¹, A²), and pressed into position by a 1600-ton press! Truss action forms a rigid framework ideal for stairs, walkways, decks, loading platforms, and engine room installations.

Maximum openings allow ample light and ventilation, but no object over one-half inch square can slip through. Rectangular or U-type construction. Variety of metals—stainless steel, aluminum alloy, etc. Riveted and Tri-Forge welded flooring available. Write for Bulletin OG-1103.

DRAVO
CORPORATION
National Distributor for
THE TRI-LOK COMPANY
Dravo Building, Pittsburgh 22, Pa.
Sales Representatives in Principal Cities

More APPOINTMENTS

Begins on page 234

Moyer, Inc. Robert E Moyer, Jr, president of R E Moyer, Inc, was formerly chief engineer of Heilman Boiler Works, Allentown, Pa. R E Moyer, Inc, manufactures weldments, pressure vessels, process machinery, etc.

Graybar Electric Co, Inc, appoints the following new operating mgrs: Charles G Campbell, Reading branch; Howard Sommer, Memphis branch; W V Quigley, Providence; M E Lee, Aberdeen, S. D.; C J Fiely, Evansville, Ohio; H C McKenney, Dayton; J C Tresnauk, Richmond. F E Gibson becomes treasurer.

Arthur D Little, Inc opens Latin American office at Edificio International 963, Reforma 1, Mexico 1, D.F., headed by Richard W Plummer.

Safety Seal Piston Ring Co is new mfg firm at 2800 W Lancaster, Fort Worth, Texas. Wm S Baker heads the firm, assisted by Weldon Baker, sales mgr, and Don Baker, asst sales mgr.

A V Smith Engineering Co names Hugh L Hamilton to manage and direct its activities.

Sylvania Electric Products, Inc appoints Raymond P Conners Eastern sales mgr of the lighting div.

D W Onan & Sons, Inc announces appointment of George R Burda as sales promotion mgr.

General Motors Corp promotes two Cleveland diesel engine div men: Tom E Hughes becomes asst gen mgr and Roger D Williams gen sales mgr.

O'Brien Steam Specialty Co, Inc, 393 Heffernan Bldg, Syracuse 2, N. Y., is exclusive U.S. distributor for Cox steam-water heaters.

F H Smith Mfg Co appoints A R Grabe national sales mgr of Fireguard fuse coupling.

American Locomotive Co names Paul N Strobell asst to vice-president of Eastern regional sales; Ralph N Darrin Jr succeeds him as Eastern districts mgr for locomotive sales and field service; Frederick Townsend becomes asst mgr for field service; Richard B Fairman is regional renewal parts mgr, Eastern section, Northeast regional office.

Thermoid Co acquires stock control of Essex Rubber Co, Trenton. Eric O Ridgway becomes director of research and development at Thermoid; and Willard H Allen is elected to the board of directors.

Conoflow Corp opens auxiliary plant in Philadelphia, to accommodate assembly and shipping operations.

Westinghouse Air Brake Co appoints W C Landis gen mgr of the air brake div,

IT WON'T ESCAPE . . . IF IT'S
BELMONT
SEALED!

BELMONT 189 . . . for cold and hot oil rods and plungers.
BELMONT 19 . . . for hot and cold water rods and plungers; low and intermediate steam rods.
BELMONT 30 . . . for high pressure steam rods, expansion joints, air, and gas.

BELMONT Packings, unlike "run of the mill" packings, are the remarkable, trouble free, product of packing specialists who have devoted more than half a century to the problem of producing packings with a *Better Seal* and *Longer Life*.

Today, more than ever before, production schedules must be maintained without interruption. Your insurance against service interruptions and mounting maintenance costs due to packing failure is BELMONT; the Packing that will withstand the ravages of TIME as well as Steam, Water, Oil, Gas, Air, Alkalies, Ammonia.

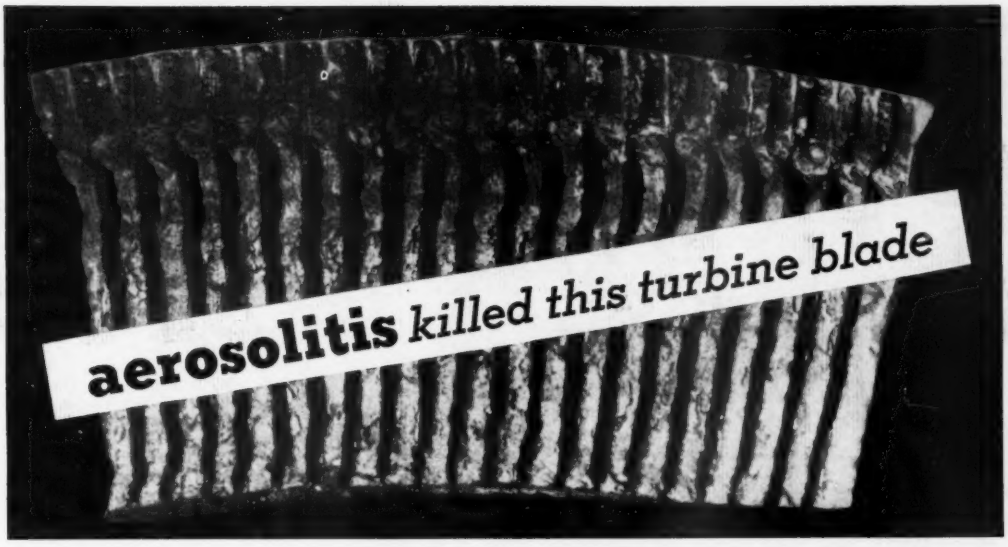
There's a Belmont Packing for EVERY SERVICE . . . hundreds of styles enable you to select the correct basic raw materials and constructions to suit individual job requirements. Packed in the blue box with the orange colored trade mark, Belmont BETTER SEALING . . . LONGER LASTING Packings are available through distributors everywhere. RINGS, SPIRALS, COILS, REELS, SPOOLS, SHEETS and GASKETS. For special engineering help, write direct.

Catalog #40 is available, write for it.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

THE BELMONT PACKING AND RUBBER CO.
Butler and Sepviva Streets
Philadelphia 37, Pa.

4-L-1A



Dearborn polyamide anti-foams prevent this

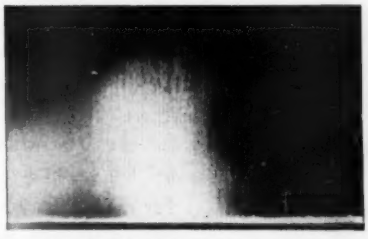
deadly boiler disease

Here is an unretouched photo of a turbine blade that was *killed by aerosolitis.* Replacement was, of course, both necessary and expensive.

But *aerosolitis*—more prevalent with some waters than with others—can be easily and inexpensively prevented with Dearborn Improved Polyamide Anti-Foams. In addition to inhibiting the formation of harmful *aerosols,* Dearborn Polyamide Anti-Foams prevent foaming to produce purer steam—eliminate scale formations—condition sludge —are compatible with other treatment.

IF YOU USE STEAM for power or process, investigate the time-, money-, and labor-saving advantages of Dearborn Polyamide Anti-Foams and the complete Dearborn Industrial Water Treatment and Engineering Service. A Dearborn engineer is at your service. The coupon is for your convenience.

DEARBORN CHEMICAL COMPANY
Merchandise Mart Plaza • Chicago 54, Illinois



AEROSOLITIS AT WORK

Aerosols are tiny drops of water dispersed in the steam which cause encrustation on superheaters, foul turbine blades. When this happens, boilers have *aerosolitis,* and costly shutdowns and repairs will result.

Dearborn Chemical Company, Dept. PO
Merchandise Mart Plaza
Chicago 54, Ill.

Gentlemen: Please send:

- ☐ Bulletin on Dearborn Improved Polyamide Anti-Foams
- ☐ Bulletin on Dearborn Industrial Water Treatment and Engineering Service
- ☐ Have a Dearborn Engineer call

Name.....

Company.....

Position.....

Address.....

City.....*State*.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

BUY REGULATION

BUY FOSTER

WHEN you spend money for a reducing valve, a temperature regulator, a pump governor, or any other type of automatic valve, what you're actually buying is *regulation*—not just a valve.

Today it is important to pick the *right* valve the *first* time. Because, with the increased demand for all types of equipment, you may not get a *second* chance.

It should be *right* 3 ways: 1) . . . to give you the regulation you need. 2) . . . to give you years of service. 3) . . . to require the least down-time for repairs.

Foster Valves meet the requirements:

1) . . . There's a type and size of Foster Automatic Valve for every service requirement, so that you can get the regulation you need without makeshifts.

2) . . . For more than 70 years Foster has been building valves that stand up. Many have been in constant service for thirty years and more.

3) . . . Foster Valves are designed so that when normal inspection and overhauls are required, accessibility makes the job quick and easy.

Foster Engineers are qualified and ready to help you get the right valve.

Buy Foster

SEE OUR CATALOG IN SWEET'S

FOSTER ENGINEERING

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . CUSHION CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SIRENS . . . SAFETY VALVES . . . FLOW TUBES

More APPOINTMENTS

Begins on page 234

and A M Wiggins gen mgr of the union switch and signal div.

Dodge Mfg Corp appoints John A Rozos director of exports.

Elliott Co, Ridgway Div, has new asst works mgr, J S Askey.

Pittsburgh Corning Corp elects L O Griffith vice-president in charge of manufacturing.

Wilmot Engineering Co establishes new engineering and sales div, and appoints these district sales representatives: Harold C Lusk, 3045 W Liberty Ave, Pittsburgh 16, Pa; Cross Pump and Equipment Co, P.O. Box 889, Charleston 23, W. Va; Crowell Engineering & Sales Co, 3045 Sutherland Ave, Knoxville, Tenn.; Jack Van Horn, 1193 Claytonia Terrace, St. Louis 17, Mo.; Amos A Culp, 930 Second Ave, N, Birmingham 4, Ala.; International Mfg & Equipment Co, 220 Broadway, New York 38, N. Y.

Wagner Electric Corp names W E Prewitt Jr to succeed L C Barton, who retired, as mgr of the Atlanta branch.

Union Carbide and Carbon Corp appoints James F Eversole mgr of research administration.

Petersburg-Hopewell Gas Co elects Francis K Godwin president.

Perfex Corp appoints George A Williams, Jr district representative in Ohio.

Hills-McCanna Co promotes Fred R Grassle to asst to the president, and R T Kidde to gen sales mgr.

Bridgeport Chain & Mfg Co New England dist sales mgr is Russell P. Sherrill.

Hunter Spring Co appoints Frank A Votta Jr chief engineer.

Battelle Memorial Institute names Lloyd R Jackson asst director.

American District Steam Co, Inc appoints Arthur H Sy vice-president in charge of sales.

OBITUARIES

Harry E Morton, 64, mgr of air handling engineering dept of Sturtevant Div, Westinghouse Electric Corp, died suddenly at Boston Oct 11.

Howard W Pound, 55, v-p and mgr of air filter sales div, American Air Filter Co, Inc, died Oct 10.

Raymond F Crump, 62, consulting engineer for the Peter F Loftus Corp, died Oct 13 in Pittsburgh.

STILL YOUR BEST BUY...

Where pipes meet permanently

W-S FORGED FITTINGS

in CARBON, ALLOY and STAINLESS STEELS

. . . Still your best buy, because W-S longer service life and increased dependability give that permanency which will lower maintenance costs . . . They are drop forged.

Basic materials are selected from a wide choice of carbon, stainless and alloy steels and then subjected to the most exacting metallurgical controls from melt to bar. Through these precautions and subsequent precision machining operations, W-S assures the utmost in accuracy of finish, perfection of threads, sockets, angles and concentricity. All W-S Fittings, — Screwed and Socket Welding Types, — are finally instrument inspected.

W-S Bulletin A3-50 details the Carbon Steel Line. Bulletin S-1 is devoted to Stainless and the Alloys. W-S will gladly furnish information on the new FEATHERLITE Fittings — a recent big step in a wide range of services. Write today for the specific bulletin you desire.

Sold Through Leading Distributors

9-L-2

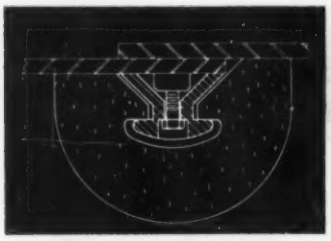
DISTRIBUTOR PRODUCTS DIVISION

WATSON-STILLMAN

Established 1848

ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment



Cross-Section of Protector Installed

What if a seam lets go?

If the plate at the girth seam or rear head seam of a riveted HRT boiler becomes weak through overheating, it incurs the hazard of opening up under pressure. That's a danger which every boiler inspector understands.

By insulating the overlapped edge of the plate and shielding it from direct impingement of blaze, a National Seam Protector prevents buckling, cracking, oxidation, and leaking. This prolongs the life of the boiler and tends to avert the risk of explosion due to seam failure.

It's well for boiler owners and insurance men to be fully informed on National Seam Protectors. Drop us a line now for explanatory literature.

National Boiler Protector Co.
929 Rybold Bldg. • Dayton 2, Ohio

MERCOID CONTROLS

Designed to automatically regulate electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement. Equipped exclusively with corrosion-proof mercury switches.

They Have What Experienced Engineers Want—
POSITIVE SAFETY • YEARS OF DEPENDABLE PERFORMANCE
EASE OF INSTALLATION • CONVENIENT ADJUSTMENTS

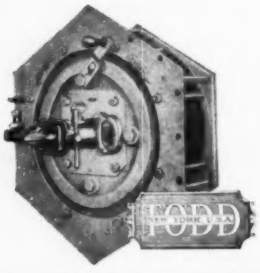
Catalog sent upon request

THE MERCOID CORPORATION
4201 BELMONT AVENUE • CHICAGO, ILLINOIS

TODD BURNERS

GAS or OIL

Setting the Standard Throughout the World



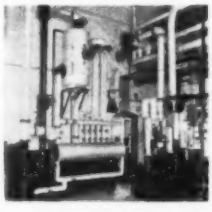
COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
81-16 45th Ave., Elmhurst, Queens, N. Y.
Distributors & Dealers Throughout U S
See Classified 'phone Books

Anybody can see the Advantages of Cochrane Continuous Blowoff System

It's as simple as this:

HEAT LOST THROUGH INTERMITTENT BLOWOFF

HEAT LOST THROUGH CONTINUOUS BLOWOFF

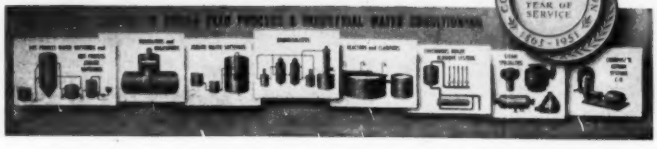


The installation of a Cochrane Continuous Blowoff System recovers practically all of the heat in the blowoff; heat which is blown directly to the sewer, in intermittent blowoff.

In a Cochrane System, employing the "flash" principle, this heat may be recovered by (1) utilization of the steam flashed from the blowoff and (2) by directing the remaining unflashed steam through a heat exchanger where heat is transferred to make-up water. A Cochrane Continuous Blowoff System saves heat, saves fuel, saves money . . . Quickly returns the original investment.

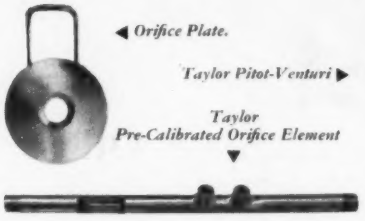
Write for a copy of Publication 4410
COCHRANE CORP., 3106 N. 17th ST., PHILADELPHIA 32, PA.

COCHRANE



LET TAYLOR HANDLE YOUR FLOW PROBLEMS

• PRIMARY ELEMENTS



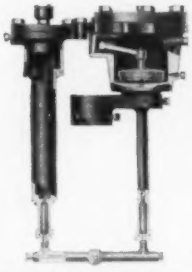
◀ *Orifice Plate.*

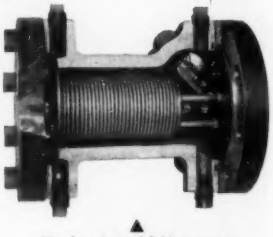
Taylor Pitot-Venturi ▶

Taylor Pre-Calibrated Orifice Element ▼

(1) Thin and thick type Orifice Plates from 2 to 24" in all standard materials. (2) Pre-Calibrated Orifice Assembly for high-accuracy with pipe sizes less than 2" are a "Specialty of the House" with Taylor. (3) The new and exclusive Taylor Pitot-Venturi Flow Element which produces greater differential with practically no pressure loss—7 to 10 times greater than by the conventional Pitot Tube. (4) Also standard Venturi Tubes. (5) Flow Nozzles from 3 to 14" in all standard materials.

• FOR MEASUREMENT



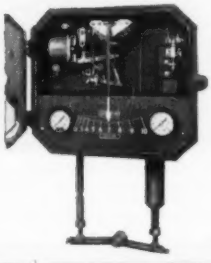


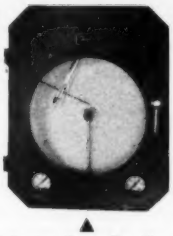
▲ *Taylor Aneroid Manometer*

◀ *New Taylor Mercury Manometer*

(1) New Taylor high-accuracy Mercury Manometer which features Teflon bearings, high energy output, submerged check valves, ½ of 1% accuracy, an adjustable leakless damping unit, and interchangeable range tubes for continuous ranges from 10 to 533 inches of water. (2) Taylor Aneroid (Mercury-less) Manometer, available in All-316 Stainless Steel or Cast Steel, accurately measures flow of hard-to-handle corrosive materials. No mercury to replace, no stuffing box. Sealing fluids or blow-back systems seldom needed. Long service. Easy cleaning. Easy range changes. Both Manometers available with Square Root Integrators.

• FOR TRANSMISSION





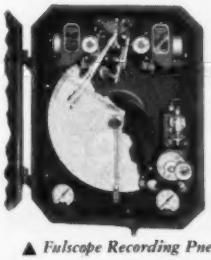
▲ *Fulscope* Recording Receiver Controller*

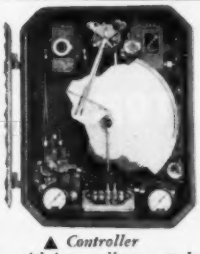
◀ *Taylor Indicating Transmitter*

Taylor Remote Transmission Systems accurately, quickly, economically, and safely transmit rate of flow to conveniently located point. Transmitters can be indicators, recorders or controllers. High accuracy—systems are calibrated to within ½ of 1% accuracy. High speed—only 2-second lag in 300 feet. Gives central control of widely distributed processes at one convenient point. Concentric dial transmitter with Mercury Manometer also available.

*Trade-Mark

• FOR CONTROL





▲ *Controller with internally mounted automatic-manual unit*

▲ *Fulscope Recording Pneumatic-Set Flow Controller*

Indicating or recording controllers in single or double duty form, with adjustable sensitivity or automatic reset. Ratio Flow Controllers with two Manometers attached. Control point may be adjusted by any other process variable. Pneumatic-set controllers whereby control point can be pneumatically adjusted from any remote location. Internally or externally mounted automatic to manual units.

• • •

For complete details, write for new Flow Catalog 98173, or ask your Taylor Field Engineer. He'll show you how Taylor Instrumentation can help you solve *any* flow problem. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Taylor's Centennial
ACCURACY FIRST
SINCE 1851

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

Lederle pumps 9,000 gallons of cooled water *EVERY MINUTE!*

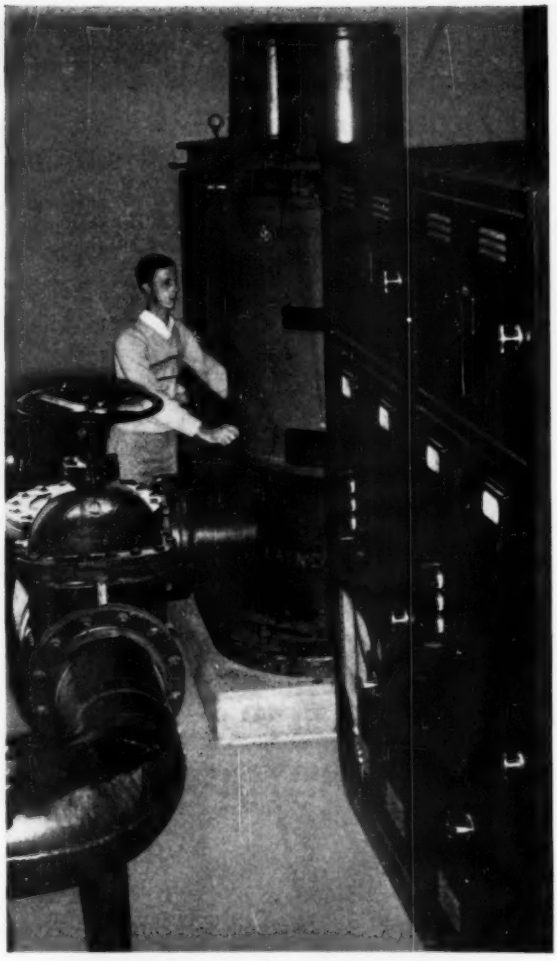
E-M Hi-Fuse Controls help safeguard supply

Seven days a week this critical supply of properly cooled water circulates from the cooling tower at Lederle Laboratories Division of the American Cyanamid Company. Vital in the manufacture of drugs and antibiotics, the water volume is kept steady and constant by E-M Hi-Fuse High-Voltage Controls for the pump motors.

At Lederle, coordinated Hi-Fuse Controls start the motors smoothly and powerfully by the E-M-developed Polarized Field Frequency Relay method . . . simplest, most effective automatic starting system ever designed. Reduced-Voltage starting feature minimizes current inrush, protecting other equipment.

If pump motors should fall out of step, Lederle's Hi-Fuse Controls re-synchronize them. Built-in short-circuit protection with high interrupting capacity fuses clears faults in less than half a cycle before motor or control is harmed. Accident-proof isolation of high voltage parts provides greater safety for operators. You can install E-M Hi-Fuse Control Panels anywhere. They are completely metal-enclosed, sturdy and safe.

Economy is important, too. Lederle's E-M Hi-Fuse Controls are as thoroughly safe and practical as circuit-breaker types of controls costing almost twice as much. Ask your nearest E-M sales engineer about Hi-Fuse possibilities for your own operation, and write the factory for Publication No. 192.



E-M Magnetic Reduced-Voltage Hi-Fuse Controls in cooling tower pump house at Lederle Laboratories Division of American Cyanamid Company, Pearl River, New York. The two 400 hp, 1200 rpm, unity power factor E-M Vertical Hollow-Shaft Synchronous Motors are seen in the background.

E-M

Originators of

AUTOMATIC CONTROLS FOR SYNCHRONOUS MOTORS

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

3300-TPA-2106

HARBISON-WALKER

Plastic and Castable Refractories

LESS TIME OUT FOR FURNACE REPAIRS AND MAINTENANCE

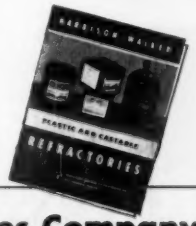
MEANS MORE PRODUCTIVE HOURS

Because you can make furnace lining repairs effectively and quickly with Harbison-Walker CASTABLE and PLASTIC Refractories, "down" time losses are reduced to a minimum. Whether the job is one of normal planned maintenance or of emergency repairs, you will find in the complete line of Harbison-Walker Plastic and Refractory Castables, the type and class especially suited for your particular application. For various original constructions also, considerable savings in time, labor and cost are secured by the use of these monolithic materials in place of preformed brick and shapes.

H-W CASTABLES comprise all classes and fulfill the special needs for highest refractoriness and spalling resistance, strength, wear resistance and insulation.

H-W PLASTICS as shipped are ready-prepared to the proper consistency for use by ramming into place. They are available in STANDARD and SUPER grades and are furnished in slabs easy to handle and apply.

WRITE for bulletin describing these products. It gives data and information for estimating your requirements.



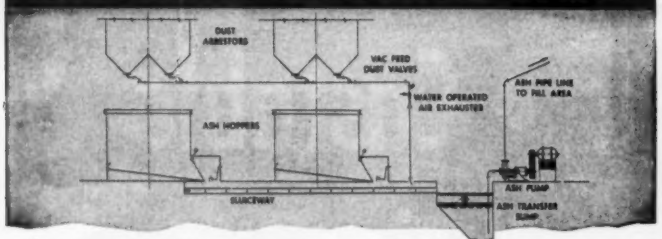
Harbison-Walker Refractories Company
AND SUBSIDIARIES

World's Largest Producer of Refractories

GENERAL OFFICES . . . . . PITTSBURGH 22, PENNA.

Need Large Capacity Ash-Handling?

CHECK WITH BEAUMONT ON A HYDRAULIC ASH-HANDLING SYSTEM



A Beaumont HYDRAULIC System is particularly suited for high capacity ash-handling; handles wet ash or dry, molten slag and large clinkers; fits any type of power plant arrangement; is completely enclosed, preventing dust or gas from escaping to the boiler room; and can be operated by one man on a part time basis.

Beaumont's Ash-Handling Division is competently staffed to give you expert recommendations on all types of ash-handling systems . . . and to provide and install the proper equipment to suit your particular requirements. Write today for the Beaumont brochure: "Answers to Your Ash-Handling Questions".

Beaumont BIRCH COMPANY

1502 RACE STREET, PHILADELPHIA 2, PA.

DESIGNERS—MANUFACTURERS—ERECTORS BULK MATERIAL HANDLING SYSTEMS

BASKET TYPE

STRAINERS

- **Large Strainer Area!**
- **Low Pressure Drop!**
- **Easily Cleaned!**

Davis Basket Type Strainers are used on pressure and suction pipe lines for the protection of meters, valves, pumps and other equipment. The No. 76 Strainer has a cylindrical basket with perforated sides and bottom supported at the top by a flange. When the cover is removed the basket may be lifted out easily for cleaning. Large body passage reduces pressure drop across the strainer to a minimum. The size of screen perforations depends on the fluid being strained and the foreign matter in suspension. Ask for recommendations.

DAVIS No. 76 STRAINER

SIZES ½" to 14"

DAVIS REGULATOR CO.

2540 S. WASHTENAW AVENUE, CHICAGO 8, ILLINOIS

NOW CLEAN GENERATORS MOTORS Without Solvents

NO Drying Period Toxic Hazards

with New Pangborn AC-4 Blast Machine

NOW YOU CAN clean electric motors, generators and turbines *without solvents!* The new Pangborn AC-4 Blast Machine scours armatures, parts, frames, coils, etc. with soft (20-mesh) corncob grits.

Since no liquids are used there is no need for drying periods and toxic or explosive hazards are eliminated. Large equipment can be cleaned *in place* and no residue is left to create gum or to break down insulation.

Simple and Inexpensive

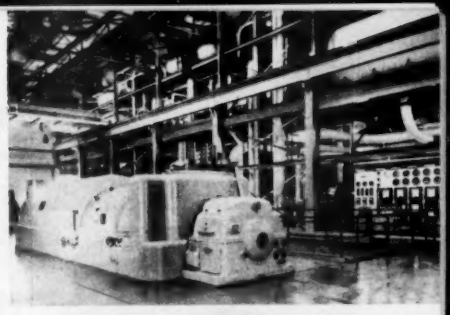
New Pangborn AC-4 Blast Machines operate from a standard 40-pound air supply. Material costs average 1/10 of other methods and complete cleaning is finished in half the time.

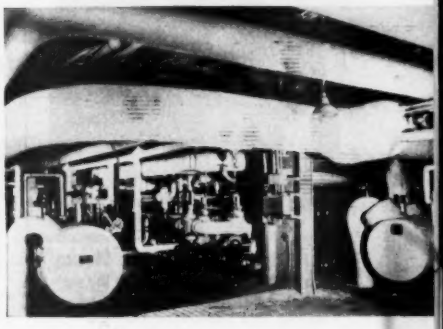
FOR DETAILS, write today outlining your operation. Address: PANGBORN CORPORATION, 90 Pangborn Blvd., Hagerstown, Maryland.

Look to Pangborn for the Latest Developments in Blast Cleaning and Dust Control Equipment

Pangborn

BLAST CLEANS CHEAPER with the right equipment for every job





Gilbert Associates, Inc., Reading, Pa. Engineers.

BLAW-KNOX POWER PIPING

WANTED HALF WAY 'ROUND THE WORLD!

IT'S a 13-thousand-mile trek from Pittsburgh, Pa. to Manila, P.I. . . . but the Manila Electric Company was willing to "pay the freight" for Blaw-Knox experience and accuracy when it came to the power piping for the great new Rockwell Power Station.

To finance and build a generating plant now supplying 200,000 customers so soon after a devastating war, demonstrates the highest degree of initiative, resourcefulness and faith in the future of the Philippine Republic. We congratulate all concerned with this project, and are proud to have been chosen as a supplier of vital equipment.

Send for a copy of Catalog No. 51 which describes the complete line of Blaw-Knox adjustable pipe hangers, vibration eliminators and supports.

POWER PIPING DIVISION

OF BLAW-KNOX CONSTRUCTION COMPANY

1525 PENNSYLVANIA AVENUE

PITTSBURGH 33, PA.

KEWANEE

HI-TEST

NoI WELD

For Power and Process Steam

50 to 180 hp—125 and 150 lbs wp

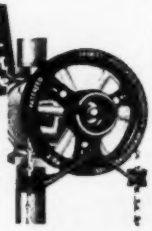
Designed for easy handling, space saving and unusual economy . . . and built in full conformity with the ASME code for hi-pressure.

For any fuel . . . mechanically or hand-fired. Quickly and easily converted from one fuel to another.

WRITE Department 89-K-12-549
for 6" scale with pipe diameter markings

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide



INSTANT
POSITIVE
CONTROL
for ALL Overhead Valves

- Pull the chain! That's all that's needed to open or close overhead valves—for complete control from the floor! Operating action of the BABBITT Adjustable Sprocket Rim with Chain Guide is as positive and immediate as that of direct manual control —and 100% safer because the risks of climbing treacherous stepladders, or on benches, machines or boilers is completely eliminated.

- The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

- Range of 10 adjustable sizes takes care of all valve makes and types: its valve wheel diameters from 2 to 30 inches. Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

To help you . . .
Install, maintain and operate electrical equipment

Here are hundreds of detailed descriptions, rules, methods, wiring and practical data.

You'll be able to solve every-day electrical problems right on - the - spot with the help of this guide. It gives you all the usable facts you need for the selection, installation, operation, care and proper application of electrical apparatus and materials. Contains complete data on wires and cables, splicing, installation and care of motors, capacitors, lighting equipment, the latest information on electron tubes and circuits and their application in industry. Imagine how much this information means to you . . . in increasing the number of jobs you can handle, in efficiency, advancement, and time, energy and effort saved.

Sixth Edition

AMERICAN ELECTRICIANS' HANDBOOK

by Terrell Croft

Revised by CLIFFORD C. CARR

1734 pages, 1327 illus., over 400 tables

$7.50

With this trouble-shooting book at your fingertips you'll see how quickly work problems can be simplified. In easy to understand language you are given the right facts in the way you want them . . . thoroughly indexed for quick finding. It covers everything from explanations and definitions of fundamentals to suggestions and ways for remedying the troubles of electrical equipment and maintaining high operating efficiency. It presents the kind of practical information that helps all practical electrical men — wiremen, contractors, linemen, plant superintendents, operators, construction engineers and others.

CONTENTS

- Fundamentals of Electricity
- Properties and Splicing of Conductors
- Circuit and Circuit Calculations
- General Electrical Equipment and Batteries
- Transformers
- Electron Tubes and Circuits
- Generators and Motors
- Outside Distribution
- Interior Wiring
- Electric Lighting
- Wiring Tables

10 DAYS' FREE EXAMINATION

McGRAW-HILL BOOK CO., Inc.
330 W. 42 St., NYC 18

Send me Croft's AMERICAN ELECTRICIANS' HANDBOOK for 10 days' examination on approval. In 10 days I will remit $7.50, plus a few cents delivery or return the book postpaid. (We pay for delivery if you remit with this coupon; same return privilege.)

Name .....
Address .....
City ..... Zone ..... State .....
Company .....
Position P-12-51

This offer applies to U.S. only.

BOILER TUBE CO. OF AMERICA

Tube Stocks and Bending

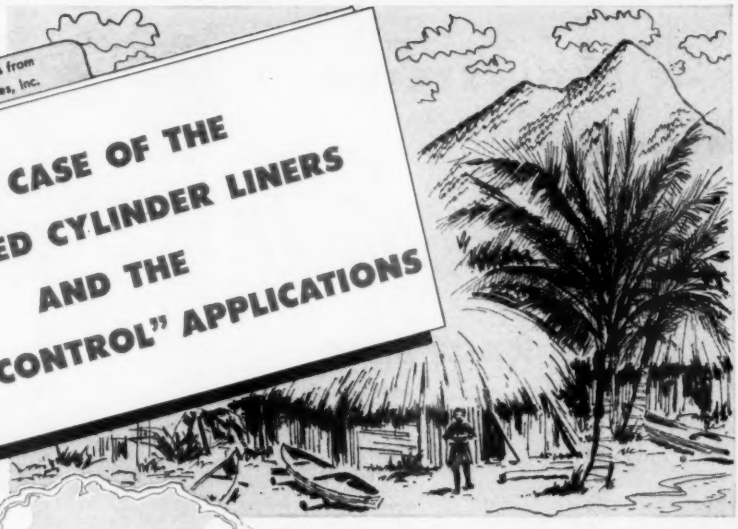
BOILER TUBE CO. OF AMERICA
McKEES ROCKS, PA.
(Pittsburgh District)

PITTSBURGH
CHICAGO

FRED S. RENAULD & CO.
LOS ANGELES

One of a series of case histories from the records of Hall Laboratories, Inc.

THE CASE OF THE CORRODED CYLINDER LINERS AND THE "REMOTE CONTROL" APPLICATIONS



Less than 300 kilometers from Caracas, Venezuela, is a growing town of 125,000, where Diesel engines provide the major source of electric power. This installation contains closed water systems for engine jacket cooling, which exchange heat to open, circulating cooling systems utilizing conventional wooden towers.

With rapidly growing power demands, water-related problems reached an acute stage. On the water side of the cylinder liners, severe corrosion evidenced itself as partial graphitization. Heavy scale formed rapidly in heat exchangers. Water storage tanks were fouled with organic growths. Plant efficiency became markedly impaired.

Fortunately, a Hall engineer had just made a survey of the entire water system. So, the Plant Superintendent arranged immediately to follow the advice of Hall Laboratories.

For the open system Hall recommended the use of Calgon and algicide with proper control of pH and blowdown. For the closed engine jacket system chromate and wetting agent were specified with control of pH.

The Plant Superintendent made tests, kept logs, and sent samples and reports to Hall via air mail. This splendid "remote control" cooperation between the superintendent and his staff and Hall Laboratories now makes possible such reports as "The liners of No. 1 Engine pulled. No evidence of corrosion" and "No need to clean heat exchangers this month."

Now, new engines and cooling systems are going in and they will be properly protected from the ravages of scale and corrosion, right from the start.

This is another example of how Hall Laboratories serves industry wherever water problems occur. Years of experience with industrial water problems prepare Hall Engineers to help you solve yours. For information, write to Hall Laboratories, Hagan Building, Pittsburgh 30, Pa.

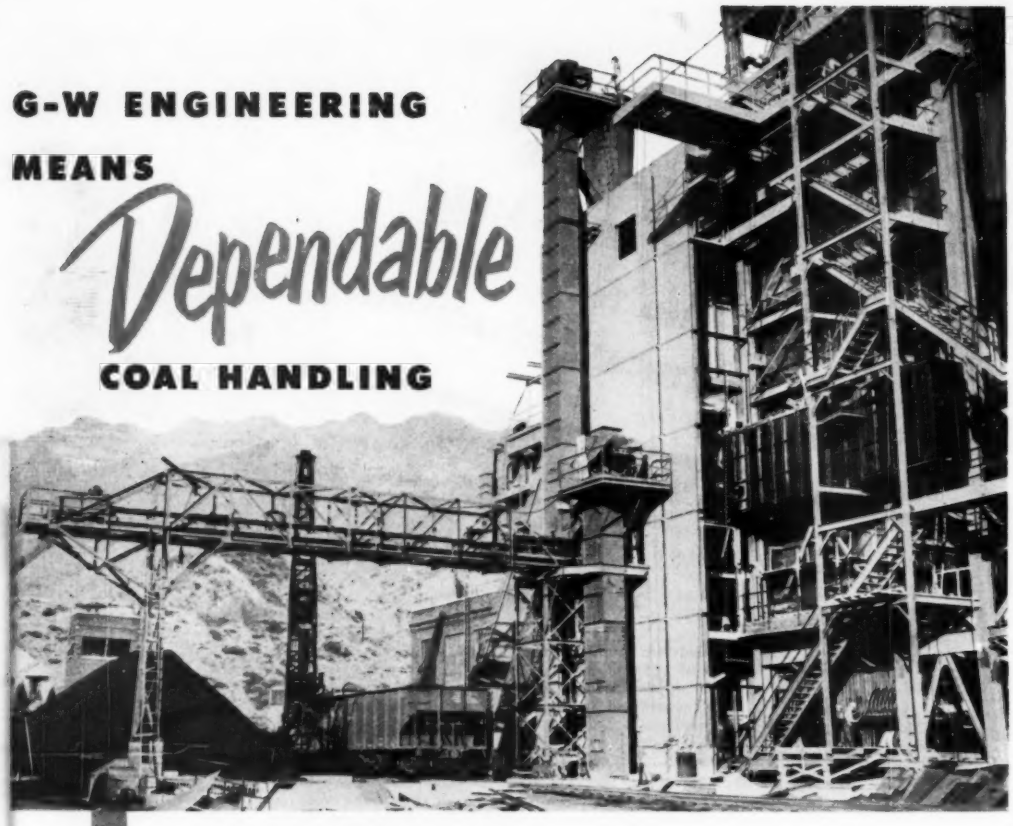
HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

HALL PLANT WIDE WATER SERVICE

Consultants on Procurement, Treatment, Usage and Disposal of Industrial Water

G-W ENGINEERING MEANS *Dependable* COAL HANDLING



The Gifford-Wood coal handling system at the Orem steam electric station of Utah Power & Light Company is designed to handle run-of-mine bituminous coal at 100 tons per hour from dual track hoppers to ground storage, or to overhead storage bins for automatic delivery to boilers. Coal handling is automatic . . . economical . . . completely dependable. The installation, protected by electrical interlocks, is a perfect example of the rugged design and flexibility that can be built into the operation of a well designed power plant.

This complete coal preparation and handling system is but one of the many solutions to dependable low cost coal handling . . . Solutions designed by G-W engineers . . . based upon over 135 years of experience accumulated by G-W in the methods of design, engineering and installation of all types of materials handling systems. Bulletin No. 300 contains the complete story. Send for your copy now, it may well lead to lowered costs tomorrow.

GIFFORD-WOOD CO.

Since 1814
HUDSON, NEW YORK

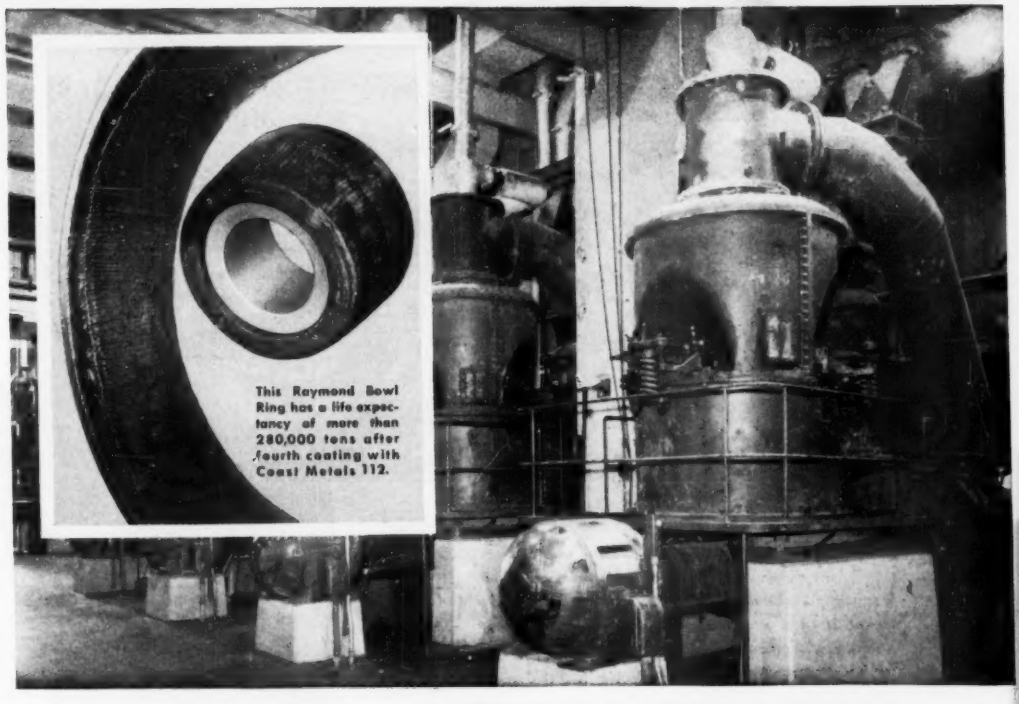
NEW YORK 17, N. Y.
420 Lexington Ave.

ST. LOUIS 1, MO.
Railway Exchange Bldg.

CHICAGO 6, ILL.
565 W. Washington St.

7655

When You Think of Materials Handling . . . Think of Gifford-Wood



Raymond Ring Hard-Faced with Coast Metals Alloy PULVERIZES 210,000 TONS OF COAL

CM-112 applied to Ring and Grinding Rolls increases life by more than 3 to 1

The Raymond Bowl Ring pictured above was photographed at a large Ohio utility plant. It has pulverized a total of 210,000 tons of coal, at 100% rated capacity, on 3 separate hard-facings with Coast Metals Alloy 112. A fourth facing, now being applied, will give this unit a life expectancy of at least 280,000 tons.

Life of uncoated rings is about 65,000 tons, after which they must be replaced. Efficiency drops off sharply after approximately 30,000 tons and the result is that production costs of remaining tonnage run high.

The history of this ring, therefore, clearly illustrates the tremendous advantages gained by Coast Metals hard-facing—proves that hard-facing with CM Alloys *pays off in a big way*.

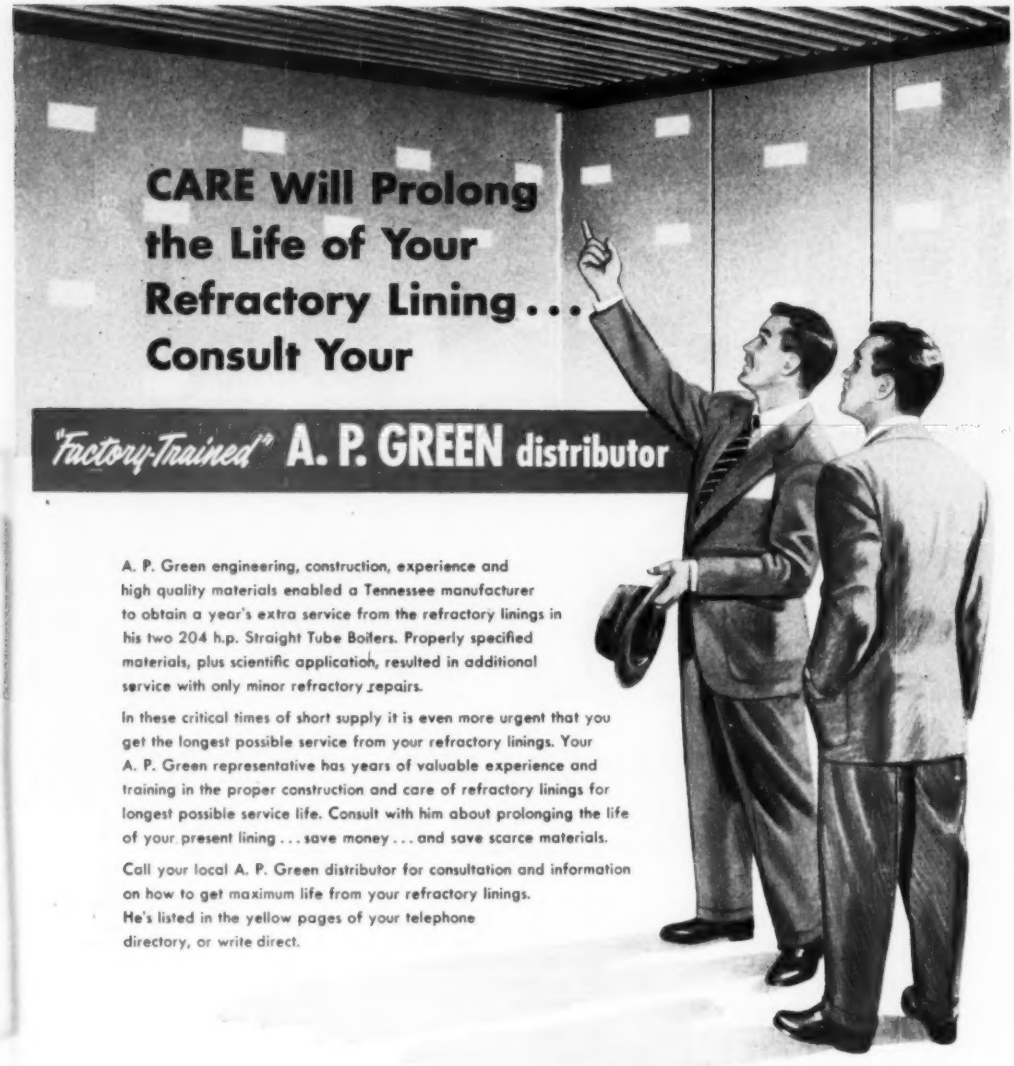
There are many other examples of how CM Alloys extend the life of parts subject to impact, abrasion, and high heat during operation: Bowl mill deflector castings and sideliner wear plates—ring retainer lugs—coal feeder screws—sluice liner castings—clinker crusher rolls—ID fan float liner plates—exhauster fan blades and impact mill plows, when hard-faced with CM *stay on the job* and continue to perform efficiently *long after* unfaced parts have become too worn to use and must be replaced.

Holding down production and maintenance costs has never been so important as it is today. So don't *replace—reface* with CM specialized weld rods. You'll not only keep production running smoothly, but save money. We shall be glad to make recommendations based upon your particular needs.

COAST METALS, Inc.

Little Ferry, N. J.

PRODUCERS OF SPECIAL HARD-FACING ALLOYS FOR THE POWER INDUSTRY



CARE Will Prolong the Life of Your Refractory Lining . . . Consult Your

"Factory-Trained" A. P. GREEN distributor

A. P. Green engineering, construction, experience and high quality materials enabled a Tennessee manufacturer to obtain a year's extra service from the refractory linings in his two 204 h.p. Straight Tube Boilers. Properly specified materials, plus scientific application, resulted in additional service with only minor refractory repairs.

In these critical times of short supply it is even more urgent that you get the longest possible service from your refractory linings. Your A. P. Green representative has years of valuable experience and training in the proper construction and care of refractory linings for longest possible service life. Consult with him about prolonging the life of your present lining . . . save money . . . and save scarce materials.

Call your local A. P. Green distributor for consultation and information on how to get maximum life from your refractory linings. He's listed in the yellow pages of your telephone directory, or write direct.

There's an A. P. Green refractory product applicable to each type of service requirement in all types of industry:

SUPER-PLASTIC, for service where operating conditions are unusually severe

PLASTIC QUIK-PAK, a high duty plastic refractory

KAST-SET, a high quality refractory castable

KAST-O-LITE, lightweight castable refractory with insulating properties.

A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

In Canada:
A. P. GREEN FIRE BRICK CO., Ltd.
Toronto 15, Ontario

A. P. Green REFRACTORY PRODUCTS

Distributors in the Principal Cities of the World

WITH **VEELOS** THE ADJUSTABLE V-BELT

You Always have the Right Size Belt When You Need It!

When endless v-belts fail and your stockroom does not have the size you need . . . that means loss of time and production. But if you're wise and have Veelos, the adjustable v-belt, in stock, this can't happen to you.

With Veelos, *any size* v-belt can be made up right from a single reel. Just four reels of Veelos in the O, A, B and C widths can replace up to *316* sizes of endless v-belts on any drive in your plant. If your machines call for only one or two widths, you stock only those reels of Veelos and *you always have the right size belt when you need it.*

Veelos has other advantages, too. Replacement time is less (never necessary to remove outboard bearings). Matched sets that stay matched can be made up instantly. You get full, vibrationless, power delivery because belt tension can be held uniform.

For full production, always— standardize on Veelos, the adjustable v-belt. Write for your copy of the VEELOS DATA BOOK today.

VEELOS
THE LINK
V-BELT

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

Made in all widths in three types: regular, oil-proof, static conducting. Also double V in A and B. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. VEELOS is known as VEELINK outside the United States.

MANHEIM MANUFACTURING & BELTING COMPANY • MANHEIM, PA.

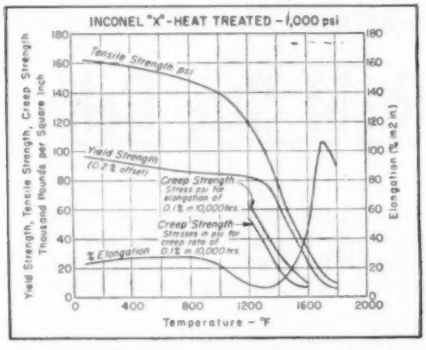
INCONEL "X"

An oxidation-resisting alloy with very high strength over 1000°F

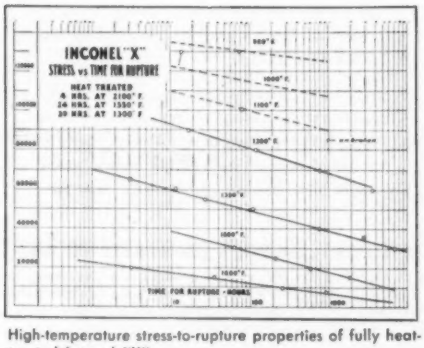
Inconel "X"® is an age-hardenable alloy which is unusually strong both at ordinary temperatures and at red heat. Suitably heat-treated, Inconel "X" has low creep rate under high stresses over 1000°F—and exceptionally high spring properties up to 1100°F.

The principal engineering characteristics of Inconel "X" (besides those shown on accompanying charts) are:

- **Oxidation Resistance**—Tests indicate that oxidation resistance of Inconel "X" is of the same order as that of Inconel.
- **Fatigue Strength**—Measurements of fully heat-treated Inconel "X" on rotating beam machines, at 100,000,000 cycles, show fatigue strengths ranging from 55,000 psi at 1200°F to 36,000 psi at 1500°F.



Short-time high-temperature properties of fully heat-treated Inconel "X".



High-temperature stress-to-rupture properties of fully heat-treated Inconel "X".

- **Impact Strength**—For fully heat-treated Inconel "X", typical impact strength values are: 33 ft. lbs. at −320°F, 37 ft. lbs. at room temperature, 67 ft. lbs. at 1500°F, and 113 ft. lbs. at 1600°F.
- **Hardness**—By proper heat treatment, the room temperature hardness of Inconel "X" can be developed as desired from BHN 140 to BHN 400.
- **Spring Properties**—By a combination of heat treatment and cold working, Inconel "X" develops unusually high spring properties. For spring applications from sub-zero temperatures up to about 650°F, it is useful where otherwise unusually strong ferrous springs must be used. Up to 1100°F, Inconel "X" springs will give useful performance where few other metals can be relied on.
- **Machining**—Inconel "X" is machinable in all conditions. Because of its strength and toughness, it cannot be machined as easily as softer metals; it can, however, be machined at satisfactory rates.
- **Forging**—No unusual difficulties are encountered in forging Inconel "X", though heavier equipment than that used on ordinary steels is required.
- **Welding**—When planning to weld Inconel "X", first refer data on the job to Inco's Technical Service Section for recommendations. Inconel "X" can be welded by nearly all commonly used methods including: metal arc, inert gas metal arc, atomic hydrogen arc, resistance spot and seam, resistance butt welding.
- **Applications**—Inconel "X" is used for springs supporting television tubes in a face coating dryer. Also for highly stressed bolts and for expansion bellows . . . wherever a combination of high stress and extreme heat must be met.
- **Forms Produced**—Inconel "X" is produced in most commonly used mill forms—billets, rod, flats, rounds, hexagons, sheet, strip, bar, wire, seamless tubes, and welding rods. Like all alloys containing nickel, it is in very limited supply except for defense use.

FURTHER DATA AVAILABLE

A 79-page reference manual "Inconel 'X', Data and Information," *contains all the engineering information compiled to date on this alloy. This publication is available, free, for your information.*

And for technical help on specific problems involving metals at high temperatures, write, outlining your problems, to Inco's Technical Service Section.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE

NICKEL (INCO) ALLOYS

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCONEL "X"®

Advertisement

IF YOU NEED PACKING ...You Need GARLOCK PACKING for *Long* Service

GARLOCK Mechanical Packings made from asbestos, flax, cotton, rubber, lead, copper, aluminum and other materials . . . Gaskets . . . KLOZURE Oil Seals . . . Mechanical Seals for Rotary Shafts . . . *all* are manufactured to the highest standards for superior performance and long, dependable service.

Also new and improved Garlock products result constantly from our expanded research program.

Let the Garlock representative survey your plant and make recommendations which will help increase your operating efficiency and lower your maintenance costs.

Write for catalog!

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

*REG. U. S. PAT. OFF.

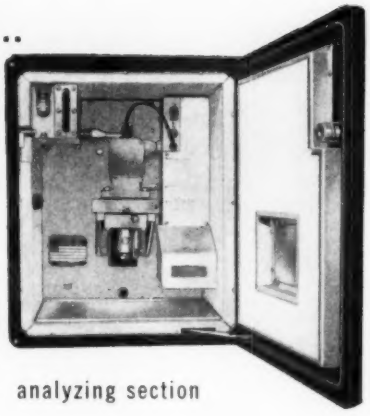
• Included in the large list of widely used Garlock products are KLOZURE Oil Seals, Lattice-Braid Packing, 117 Valve Stem Packing, Chevron* Packing, Bitan* Leather Cups, "Teflon" Gaskets.

GARLOCK

PACKINGS, GASKETS, KLOZURE* OIL SEALS, MECHANICAL SEALS

for large industrial power plants and central stations...

a new CO_2 RECORDER using three established ideas



analyzing section

Designed to handle the CO_2 measurement problems of large industrial power plants and central stations the new *Hays Condu-Therm CO_2 Recorder* uses three established ideas:

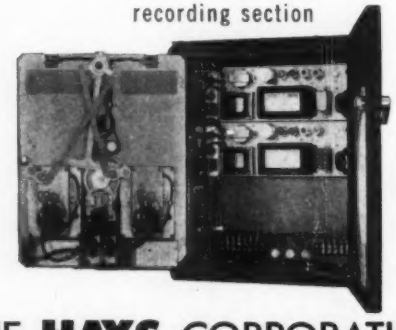
1. *The use of CO_2 measurement as a guide to combustion efficiency* . . . has been used by thousands of boiler plants and industrial furnaces, particularly where a single fuel such as natural gas, oil, bituminous or anthracite coal is being burned.

2. *The thermal conductivity principle of gas analysis* . . . has been accepted extensively in the process industries, because of its fast response to changes in gas composition, its freedom from chemicals, and its proven reliability.

3. *Electronic type operation* . . . frees the instrument of the step action and delicate construction commonly found in galvanometer operated instruments . . . also adds greater speed, power and magnification, while assuring high accuracy and permanency of calibration.

features five second response with ±.25% accuracy

recording section



the condu-therm features:

- ***5 second response to CO_2 change due to:***

  rapid change of sample gas in gas passage system

  small volume of gas in analyzing cell

  continuous connection (through amplifier) between analyzer and recording pen motor

- ***±.25% accuracy for chart ranges up to 0 to 20% due to:***

  slide wire construction . . . 5 tolerances held to .1%

  recording pen cam precision-machined to .0001 in. high power gain (2.5 million)

- ***"Boiler plant" construction unavailable in any other instrument:***

  linkage of ⅛" x ½" bar

  multiple pen bearing of telescoping stainless steel tubes

  oilite bearings do not require lubrication

  chart plate of ¼ in. permanent mold casting

  unit construction for easy replacement of each main element

For full information on the Hays Condu-Therm CO_2 Recorder write for Bulletin 51-1008 which includes:

detailed explanation of operation of analyzing and recording sections

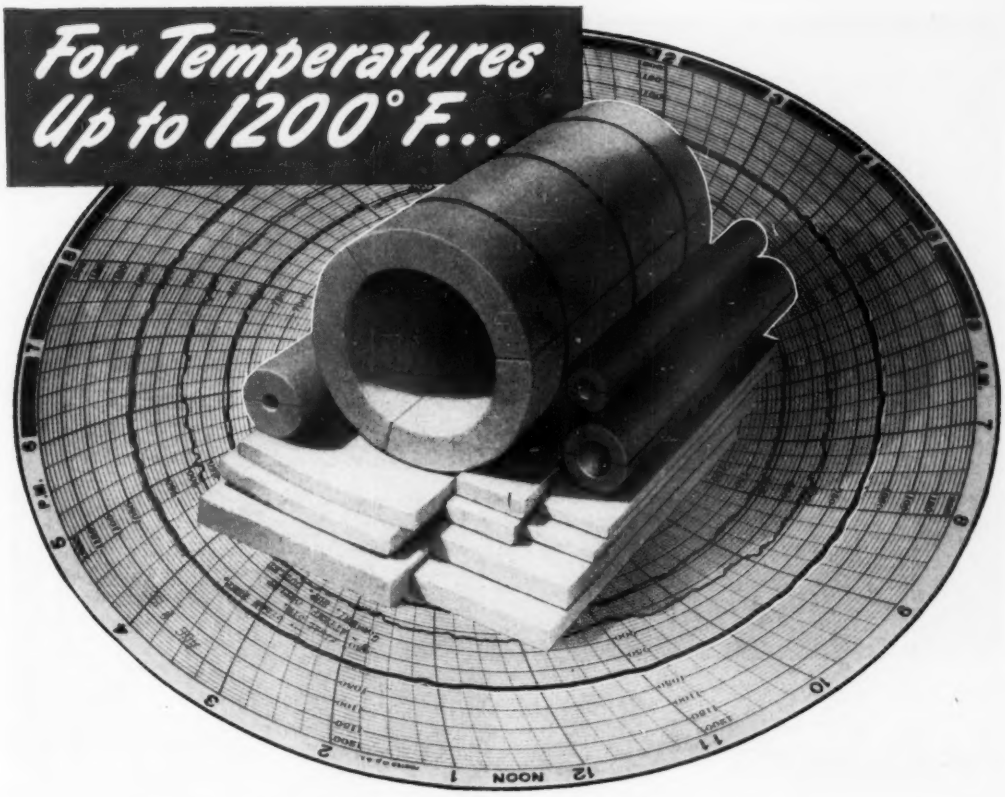
completely illustrated discussion of component parts and features

drawings of and information on gas sampling systems.

THE **HAYS** CORPORATION
MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

For Temperatures Up to 1200° F...



One Material Insulates The Entire Job — Better

Wherever the saving of heat is a factor . . . for temperatures all the way up into the superheated range, *one* material provides outstanding performance—Kaylo Heat Insulation.

The structure of this revolutionary heat-saving material, a hydrous calcium silicate, is composed of countless sub-microscopic air spaces giving it high insulating value. Its wide *effective* temperature range—up to 1200°F.—eliminates the need for combination coverings in nearly all operating conditions.

Kaylo Heat Insulation is inorganic, incombustible and insoluble in water; has remarkable dimensional stability—properties which contribute to its continued efficiency and long service life.

The high strength of Kaylo Heat Insulation makes spoilage almost negligible, in transit and on the job. Although Kaylo Heat Insulation is strong, it is extremely lightweight. Its ease of handling, cutting and fitting helps speed application.

For complete details on Kaylo Heat Insulation, write Dept. N-195, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

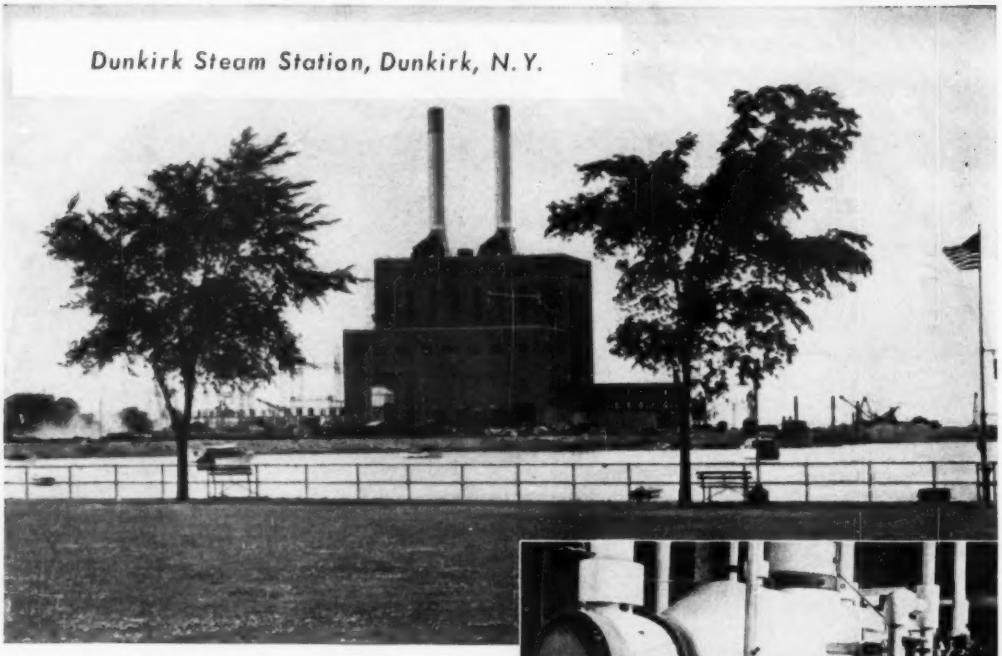
SEND OUT FOR CATALOG

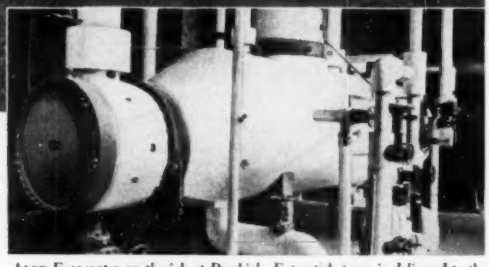
KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS-ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

Dunkirk Steam Station, Dunkirk, N. Y.





ALCO *Evaporator on the job at Dunkirk. Extracted steam is delivered to the tubes at 72 psia and 285° superheat to produce 16,400 pounds per hour of net vapor.*

How Alco Evaporators give this station

High purity make-up water

Typical of the effective engineering which keynotes the design of this 160,000 kw plant of the Niagara Mohawk Power Corporation, are the two ALCO evaporators, each of which furnishes 20,000 pounds per hour of high purity make-up water for the two 80,000 kw generating units.

These single-effect evaporators are of the ALCO patented "Flextube" thermal descaling type. Each evaporator contains 586 square feet of effective heating surface comprising 80-20 Cupro-nickel tubing, and uses a centrifugal type vapor purifier. Maximum working pressure for the shell side is 100 psig; for the tube side, 150 psig.

Other ALCO equipment in this new station includes high pressure extraction feedwater heaters, drain coolers, and evaporator condensers—all playing an important part in maintaining peak efficiency in this reheat cycle plant.

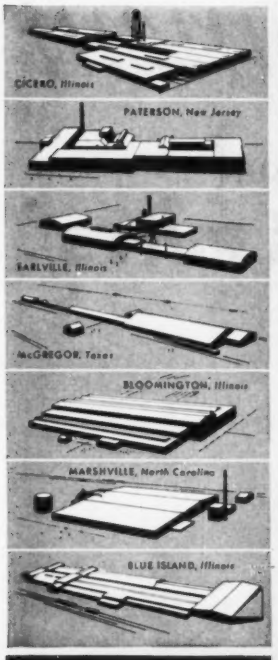
Check these other ALCO *Evaporator design features:* ample vapor disengaging space . . . separate, removable channel and cover . . . patented ALCO compression bolting. All add to the effectiveness of the evaporator. Write now for more details, or call the nearest ALCO Sales Engineer at Chicago, Houston, Kansas City, Los Angeles, New York or Tulsa. Plants: Dunkirk, N. Y. and Beaumont, Texas.

ALCO

ALCO Products Division

AMERICAN LOCOMOTIVE COMPANY

***In step with tomorrow*—ALCO AIRCOOLERS, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**



***7** plants serve many industries' needs for . . .*

- **PIPE INSULATION**
  Amocel
  Unibestos No. 750
  Unibestos No. 1200
- **UNIBESTOS INSULATING BLOCK**
- **UNARCO METAL FACED INSULATING BLANKETS**
- **INSULATIONS . . . TAILORED-TO-FIT**
- **SEWN AND CEMENTED INSULATING BLANKETS**

EVER BETTER INSULATION SO THAT INDUSTRIES CAN

Save Btu's on pipes of peace or war

Whatever your insulation problem, whether it is to retain heat or cold; whether it is a conventional pipe application or a unique or complicated condition involving close quarters and the need for the most rugged construction, Unarco has a type of insulation to help you meet the problem most efficiently and economically. Unarco engineers utilize the best material for the job with many exclusive Unarco construction features that have made these insulations a standard in industry.

Write for copy of "Mobilized to Serve You"

UNARCO

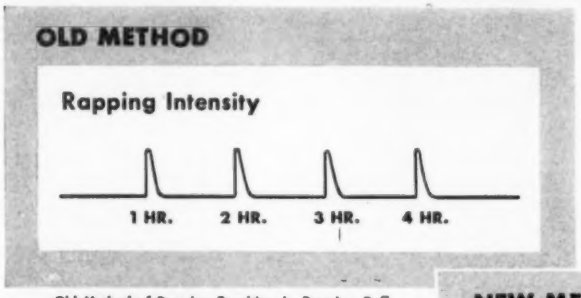
UNION ASBESTOS & RUBBER COMPANY

332 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILLINOIS • DEPT. 1819

New Development

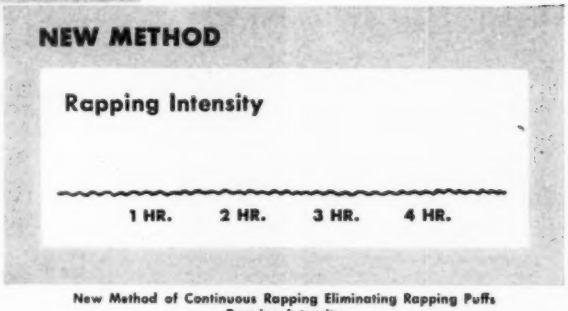
FOR ELECTRICAL PRECIPITATORS

ELIMINATES RAPPING PUFFS



Old Method of Rapping Resulting in Rapping Puff

Here are two simple diagrams that clearly demonstrate the importance of the new method of rapping developed by Research Corporation. The first shows the old way in which dust is shaken loose from electrodes at *periodic* intervals, causing intermittent puffs or clouding.



New Method of Continuous Rapping Eliminating Rapping Puffs
Rapping Intensity

This second diagram illustrates the new scientific method of cleaning electrodes. It involves continuous or sequential rapping, every minute or less, at a controlled vibrational intensity. This converts precipitation from a batch operation to a *continuous and uniform process.*

This is another major contribution by Research Corporation to the field of electrical precipitation. Constant research and development work for the past 39 years has resulted in many other improvements over the first Cottrell Precipitator. These advances plus the unequaled experience gained through over 1000 installations, listed at right, assure you of a profitable solution to your specific problem.

RESEARCH CORPORATION INSTALLATIONS

55 Carbon Black Plants
208 Metallurgical Installations
215 Acid Plants • 34 Paper Mills
293 Detarring Installations
251 Power Stations
86 Steel Plants • 114 Oil Refineries
and Miscellaneous Installations

Want to know more about the new Rapping System? Bulletin FA contains additional data. Send for your copy.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois
Bound Brook, New Jersey

RC-133

. . . never failing source of Power for Defense

The United States has maintained its stature as the world's foremost industrial nation because of its vast natural resources and far-ranging railroad distribution system. These resources include the coal which keeps our plants and factories running.

In our great periods of peaceful industrial growth and production, coal has been our gauge of power. In wartime, coal has meant basic and limitless strength . . . power without interruption. Today, when the free world is producing for defense of freedom, we must credit coal as a great trick-taking trump in our arsenal. Coal, dependable and always available, is the sure-fire source of the energy necessary to limitless production.

Along the lines of the Pennsylvania Railroad are mines which produce every type of coal to meet industrial and domestic needs. These vast coal reserves on the Pennsylvania lie close to major consuming areas . . . a fact of importance to you when you plan for tomorrow's power.

PENNSYLVANIA RAILROAD

There's only one
TAPER-LOCK

Precision-Grooved

True Running

Easy on—Easy off

TAPER-LOCK bushing grips the shaft for the full length of the bushing — holds sheave with firmness of a shrunk-on fit. No wobble. Taper-Lock runs true!

No flange—no collar—no protruding parts. Flush machine-tool appearance.

Finest grade of close-grained semi-steel, cast in the Dodge foundry.

The grooves, machined on precision equipment, have identical pitch diameters. This insures equal belt tension. Every belt pulls its share of the load!

TAPER-LOCK sheaves are available from distributors' stocks in complete range of sizes in A, B, C and D grooves.

DODGE SEALED-LIFE BELTS have special protection for tension members, insuring longer belt life. Perfectly matched to TAPER-LOCK sheaves.

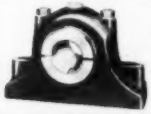
DODGE MANUFACTURING CORPORATION, 3200 Union Street, Mishawaka, Ind.

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Equipment" in your classified phone book.

FIRST IN POWER TRANSMISSION MACHINERY!

V-BELTS AND TAPER-LOCK SHEAVES



DODGE-TIMKEN PILLOW BLOCKS

ROLLING GRIP AND DIAMOND D CLUTCHES

SOLID STEEL CONVEYOR PULLEYS

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS

Zallea Expansion Joint News

PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

Expansion Joint of the Month

LOW PRESSURE TYPE

The Zallea Low Pressure Corrugated Expansion Joint is used to absorb vibration and protect machinery. Made of stainless steel, these joints are of the non-equalizing type and are limited in

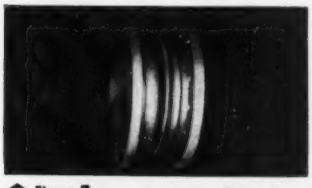


Figure 7

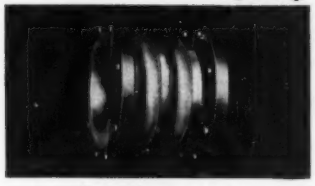


Figure 8

service to ½" maximum axial movement and 50 lbs. maximum working pressure. Furnished with a single corrugation (Figure 7), or with multiple corrugations (Figure 8), they are primarily used on condensers, turbines, stage bleeders, pumps, and between connected equipment where slight movement and vibration occurs. Industry, with its increasingly high temperature problems, relies on the Zallea Low Pressure Corrugated Expansion Joint for smooth flow and maximum operating performance. For your expansion problem, always specify the *best* in expansion joints . . . specify *Zallea*, you'll find it pays!

. . . a brand new 4-page folder on *all* Zallea Expansion Joints. Send for your copy of Bulletin 351 today!

ZALLEA BROTHERS, 814 Locust Street, Wilmington 99, Delaware.

OPERATION D-E-E-P FREEZE

Our Readers Ask

Q. *A friend and I recently had a friendly argument over copper vs stainless steel expansion joints. What are your views? A. T. M., Conshohocken, Pa.*

A. Except where corrosive conditions prevent, stainless steel may be used wherever copper is used. Although slightly more expensive in its initial cost, the use of stainless steel will result in much lower overall cost because of its increased life. Having approximately three times the tensile strength of copper, stainless steel elements can be made with a wall thickness approximately ⅓ that required for copper to withstand the same working pressure. As the life of a corrugated element varies inversely with the thickness of the element, a stainless steel expansion joint will last several times longer than a copper expansion joint designed for the same operating pressure.

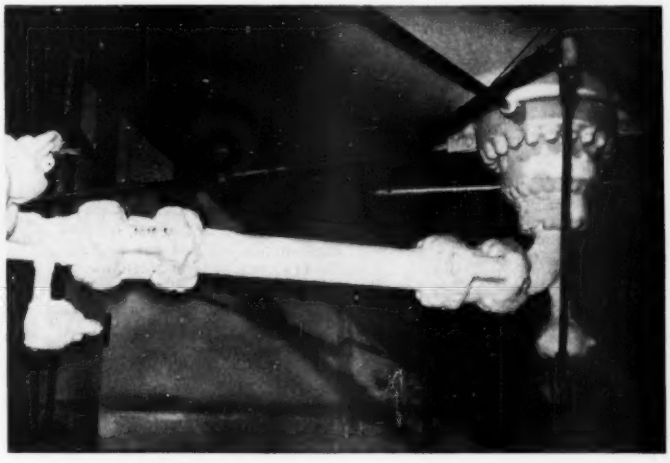
Your questions are welcomed. Address all letters to Engineering Dept. 917.

Temperature and Pressure Problem Solved by Zallea

Recently Zallea engineers were faced with a problem of developing expansion joints for operation on a liquid oxygen line, operating at —320° F., under extreme pressure at a large classified government facility. Because of the unusual nature of this installation, Zallea engineers designed *both* the piping layout and the expansion joints. Special stainless steel alloys were selected for the expansion joints to withstand the severe operating conditions.

Zallea Joints Tested

Shown here in operation, under a heavy layer of frost, are two of a group of 14 six inch Zallea Toroidal Hinged Type Stainless Steel Expansion Joints, with stainless steel construction throughout including the hinges and flanges. Prior to shipment, these Zallea Stainless Steel Expansion Joints were factory-tested to 1400 pounds hydrostatic pressure for a period of 8 hours to insure long life and satisfactory job performance.

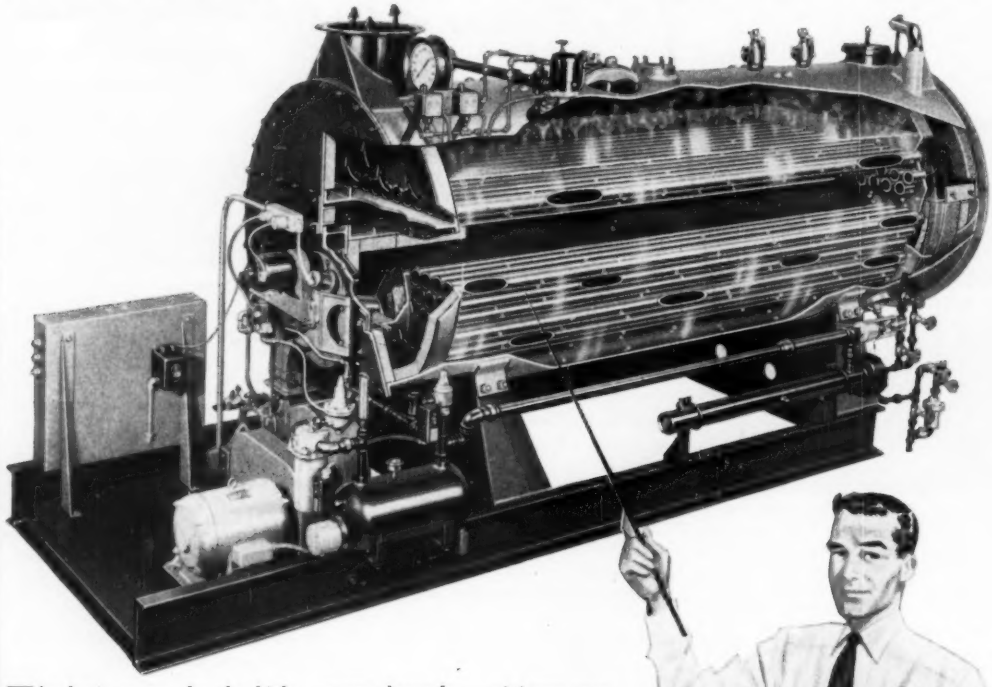


Advertisement

CLEAVER-BROOKS STEAM BOILER

Four-Pass Construction

MEANS HIGH HEAT TRANSFER — GUARANTEED 80% EFFICIENCY



The basic reason for the high thermal efficiency and low fuel costs of Cleaver-Brooks Steam Boilers is graphically shown above.

Note the original and exclusive Cleaver-Brooks four pass construction of the boiler. The four complete passes of combustion gases traveling through the entire tube length of the boiler proper enables the boiler to absorb the greatest practicable amount of heat from the fuel burned.

All Cleaver-Brooks boilers are of the four pass design and the maximum useable heat is absorbed in these four passes before the combustion gases leave the boiler.

Cleaver-Brooks steam boilers offer many advantages . . . quick, effortless response to fluctuating steam demands — minimum manpower needed for operation and maintenance — clean — space saving — low cost installation — dependable performance — burns the fuel most available and most economical in your area — oil or gas.

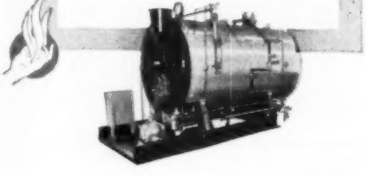
Remember the name Cleaver-Brooks, it stands for the first and finest in steam boilers. Standard models available in sizes from 15 to 500 HP, 15 to 250 psi, oil, gas, combination oil and gas firing.

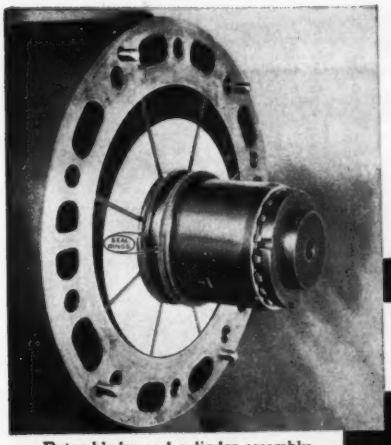
CLEAVER-BROOKS COMPANY
301-M E. Keefe Ave., Milwaukee 12, Wis.

Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

Write for your copy of the latest illustrated Cleaver-Brooks Boiler Catalog. It tells and shows why Cleaver-Brooks Boilers will save you money.

Cleaver-Brooks
STEAM BOILERS
the first and finest of their class

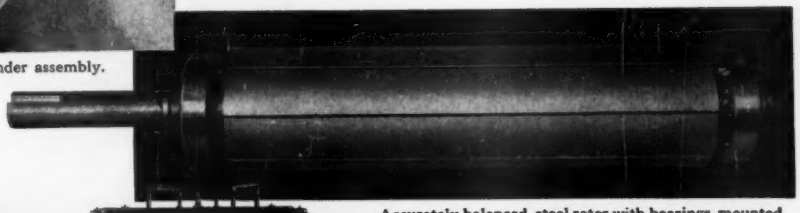




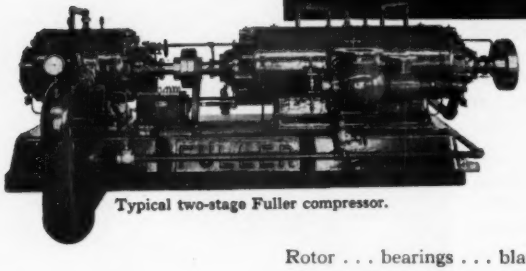
Rotor blades and cylinder assembly.

a lot of maintenance men have never seen inside a

FULLER COMPRESSOR



Accurately balanced, steel rotor with bearings mounted.



Typical two-stage Fuller compressor.

Rotor . . . bearings . . . blades—the only moving parts in a Fuller Rotary Compressor. There you have the three reasons why these compressors keep out of the repair shop. Fuller's efficient "heart" is your guarantee of economical and dependable service.

These are some of the important advantages of the Fuller Rotary—the reasons why thousands of these compressors are quietly and efficiently working for industry today: steady flow—no air-line pulsations, no valves to leak, direct drive from electric motor or internal combustion engine, simple foundation and small floor space, **maintained** capacity and efficiency for the life of the machine.

Whether your requirements call for a single-stage, two-stage or duplex combination, Fuller has the compressor **(to 125 psi. and 3300 cfm)** that will do the job better—longer. Investigate the Fuller Rotary Compressor. Complete information is given in Bulletin C-5. It's yours for the asking.

Fuller

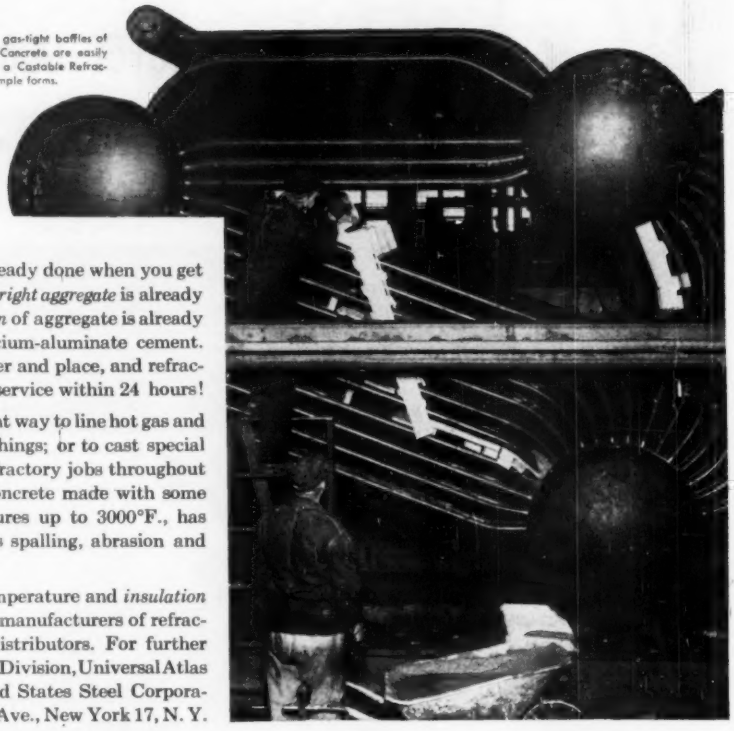
DRY MATERIAL CONVEYING SYSTEMS AND COOLERS • COMPRESSORS AND VACUUM PUMPS FEEDERS AND ASSOCIATED EQUIPMENT

FULLER COMPANY
Catasauqua, Pennsylvania
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

C-217

CASTABLES give you a *head start* on your next Refractory job

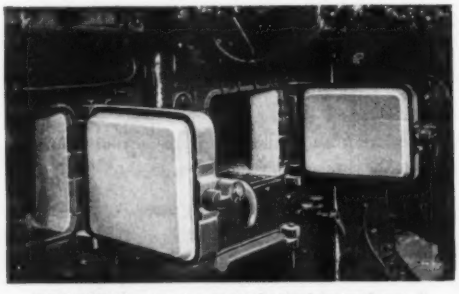
Monolithic, gas-tight baffles of Refractory Concrete are easily made with a Castable Refractory and simple forms.



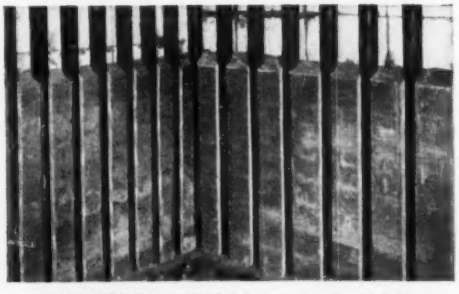
TWO PARTS OF THE JOB are already done when you get Castable Refractories. The *right aggregate* is already selected. The *right gradation* of aggregate is already mixed with Lumnite* calcium-aluminate cement. All you do is mix with water and place, and refractory concrete is ready for service within 24 hours!

That's the fast, convenient way to line hot gas and air ducts, stacks and breechings; or to cast special shapes . . . and do many refractory jobs throughout your plant. Refractory Concrete made with some Castables takes temperatures up to 3000°F., has low volume change, resists spalling, abrasion and corrosion.

CASTABLES to meet specific temperature and *insulation* requirements are made by manufacturers of refractories and sold by their distributors. For further information, write Lumnite Division, Universal Atlas Cement Company, (United States Steel Corporation Subsidiary), 100 Park Ave., New York 17, N. Y.



DOOR LININGS made with adaptable Castable Refractory Concrete. Unnecessary to stock large inventories of special shapes. Instead, special shapes can be cast in place or poured in molds as needed. Volume change is negligible.



TUBE PROTECTING Water Wall Studding made with a Castable Refractory is tough and highly radiant, uses a different aggregate than baffles (above). With Castables you get Refractory Concrete tailor-made for the job.

"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

P L-8

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network

BIRD-ARCHER'S COMPREHENSIVE 8 POINT WATER TREATMENT SERVICE

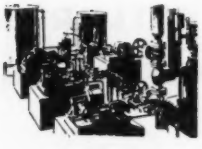
Even if your present water treatment methods **appear** satisfactory, it will pay you to look into Bird-Archer's 8-point water treatment service. Any or all of this comprehensive, efficient service is available to you. Talk to your Bird-Archer representative about it next time he calls. Or, write us now to arrange a consultation. No obligation, of course.

What Bird-Archer Does

1. Surveys Plant—Bird-Archer makes a complete study of plant operation involving the use of water or steam . . . checks present equipment and past performance.

2. Studies All Available Water — Starting at the source, Bird-Archer makes exhaustive analyses of water supplies.

3. Develops Treatment and Control Systems—On the basis of these comprehensive studies, Bird-Archer develops a complete system of treatment and control, including necessary operational changes.

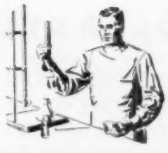


4. Specifies Equipment that May Be Necessary — Bird-Archer determines whether installation of additional equipment will be helpful . . . analyzes benefits to be derived.

5. Furnishes Proper Chemical Treatments When Required—For more than a half century, Bird-Archer has manufactured specifically formulated treatments to solve individual problems.

6. Instructs Plant Staff—Plant personnel is carefully instructed by experienced technicians in the application of treatment and control . . . teaches simple, accurate test procedures.

7. Makes Periodic Check-Ups—To make certain that the recommended system is providing the best possible results, a Bird-Archer Service Engineer makes regular, personal check-ups.



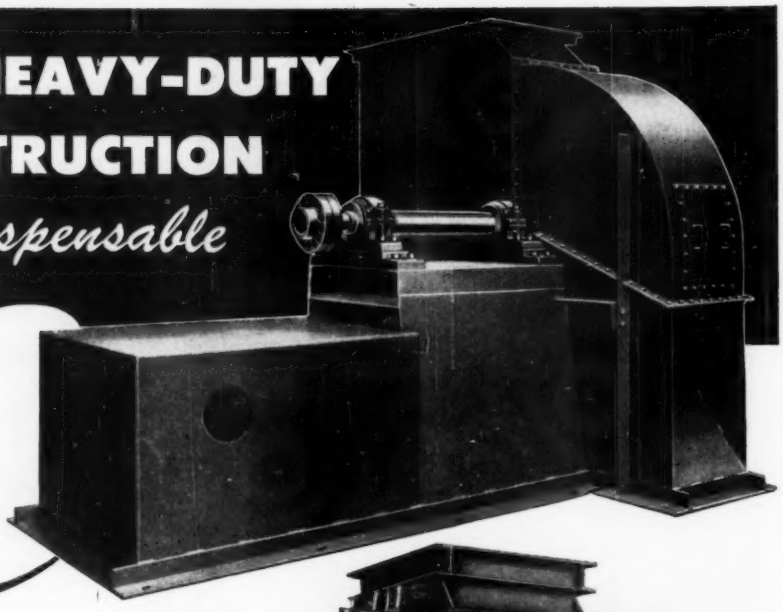
8. Offers a Laboratory Service for Scientific Analysis—Modern Bird-Archer laboratories, staffed by trained chemists, specialize in water analyses and research . . . check accuracy of plant control.

BIRD-ARCHER WATER TREATMENT

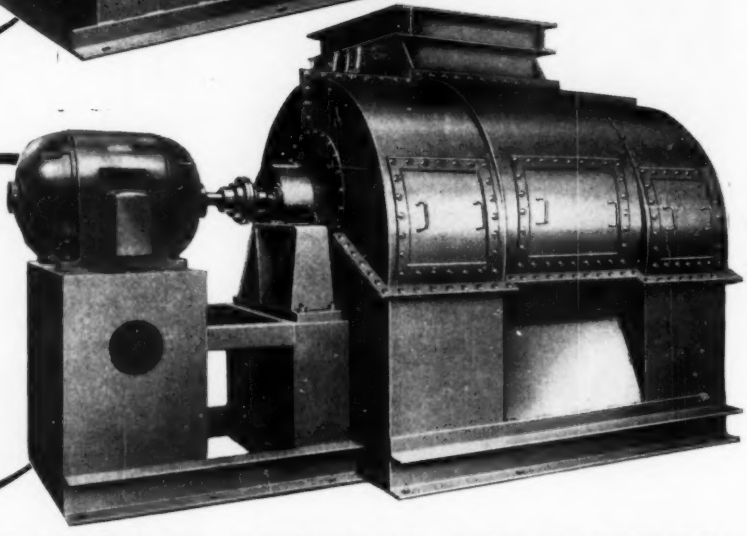
THE BIRD-ARCHER COMPANY, 4337 NORTH AMERICAN ST., PHILADELPHIA 40, PA.
NEW YORK • CHICAGO
IN CANADA: The Bird-Archer Co., Limited, Cobourg, Ontario
IN MEXICO: Calderas y Accesorios, S. A., Amsterdam 291, Mexico, D. F.

BA 157

Now HEAVY-DUTY CONSTRUCTION *is Indispensable*



HEAVY-DUTY single width fan for handling large volumes of air at high pressures—either supply or exhaust applications. Speeds suitable for motor or turbine drive.



HEAVY-DUTY double width fan for handling large volumes of air at medium high temperatures. Fan cooled bearings (Clarage development) insures satisfactory operation despite heat.

YOU CAN'T TOLERATE PROCESS AIR FAILURES IN DEFENSE PRODUCTION

Durability plus! . . . fan equipment to master the toughest assignments . . . fans to meet any size, any type of air handling need! **Clarage HEAVY-DUTY equipment** is built above and beyond the demands of average service. It is the make of equipment so many engineers in industry prefer for their **most important fan jobs.** We welcome your inquiry for any desired data.

CLARAGE FAN COMPANY
KALAMAZOO, MICHIGAN

CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

...from billet to tube to fitting

From this modern control room, every step in the heating, piercing, rolling and reduction of seamless tubes is closely monitored. This is typical of the highly specialized equipment demanded by the Globe precision process . . . insuring high quality and close tolerances.

GLOBE highly specialized process controls are used to produce the finest in WELDING FITTINGS

For complete information on the finest welding fittings available anywhere, send for the Globe Welding Fittings Catalog.

Globe precision-process manufacture *begins with the billet* — continues through the making of the seamless steel tube — (Globe alone among welding fitting manufacturers produces seamless steel tubes) — and extends through to the production of the finished fittings.

Because Globe has highly specialized controls — at every stage of manufacture *in its own plant* — you can be sure of uniform high quality seamless welding fittings when you specify Globe.

GLOBE STEEL TUBES CO.
MILWAUKEE 46, WISCONSIN

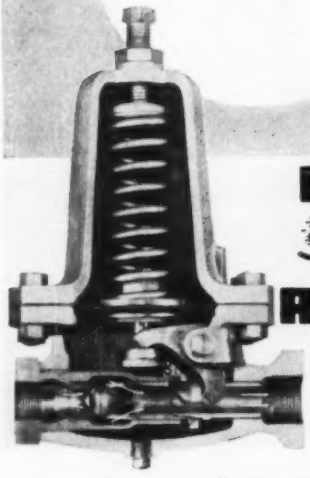
Chicago, Cleveland, Detroit, New York, Philadelphia, St. Louis, Denver, Houston, San Francisco, Glendale, Cal.

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy — carbon — seamless steel tubes — Globeiron (high purity ingot iron) seamless tubes — Globe Welding Fittings.

EXTRA LARGE CAPACITY
TIGHT CLOSING CHARACTERISTICS
CLOSE DELIVERY PRESSURE CONTROL
WIDE RANGE OF ADJUSTMENT

Combine to Give You..

SMOOTH OPERATION
SPEEDIER PRODUCTION
NO SPOILAGE



CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVES

The "1000" valve is single seated and its valve makes line contact with its seat ring which accounts for its tight closing characteristics. The unusually long diaphragm spring insures sensitive pressure control.

Steam, water, air, oil, etc. flow through this valve in a straight line—nothing is in the path of flow to cause turbulence — therefore, peak flow is never a problem.

TURBULENCE LIKE THIS *Eliminated*

The inner valve is streamlined — no back eddies to hinder flow — valuable when you want all possible fluid to go through the valve to meet peak demand.

Turbulence eliminated by venturi approach to the valve seat — it means better flow. The inlet pressure is confined to a small cylindrical chamber, the same being advantageous for high pressures.

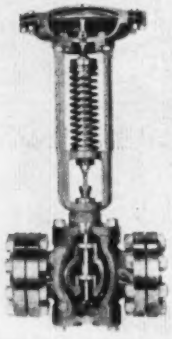
YOU GET THIS *Streamlined* PATTERN

Write for bulletin "1000" that fully explains the cost-saving benefits that begin with installation and last for years.

CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 34 Pressure Reducing Valve. For practically all fluids. Has roller bearing, also roller guides that kill side strains and stop packing trouble —no lost motion.

Sizes: ½" to 12" inclusive Highest initial pressure 800 lbs.; reduced pressure vacuum to 150 lbs. Bodies: iron, bronze, steel. Trim: iron, bronze, stainless steel. Ends: screwed, flanged, ammonia type, welding type. Bulletin 968.

Cash Standard Type 30-AP Valve gives precise control of fluid pressures, through a pilot connected to the pressure under control. For steam, water, air, and most fluids.

Can be a pressure reducing valve or a back pressure valve depending on the way the control lines are connected. Pressures up to 600 lbs. Sizes ½" to 12" screwed; 1" to 12" flanged ends; wide variety of metals.

may be robbing your plant, too!

Guck is sludge, oil, line scale and other objectional entrainment in pipelines and equipment handling steam vapor, compressed air or gases.

For years "guck" has been robbing the industrial plants of America! Guck in exhaust gases and steam fouls costly equipment, causing downtime, increased maintenance and reducing efficiency. Guck in many cases makes exhaust steam so objectionable that it cannot be reclaimed. Guck vented with spent gases and vapors damages plant equipment and buildings.

Anderson Hi-eF Purifiers are the one sure way of ending not only "guck" but all steam and vapor entrainment problems. They clean up compressed air and steam lines, protect production and steam equipment, stop nuisances from vented gases and steam. In processing plants they economically reclaim the valuable solids in gases and vapors arising from the materials as it is processed.

The unique centrifugal element design of Anderson Hi-eF Purifiers is guaranteed to remove 99% of entrained liquids, solids, condensate, oil and greases from live and exhaust steam, processed gas, air and chemical vapors. These units cost much less than you might expect . . . require no maintenance . . . are self cleaning . . . and last a lifetime. If you you have a "guck" problem write to Anderson. Our engineering staff, with an impressive background of purifier experience, will gladly solve your problem.

LINE TYPE PURIFIER Bulletin #200
DOWNFLOW INTERNAL PURIFIER Bulletin #400
RECEIVER TYPE PURIFIER Bulletin #300
INTERNAL TYPE PURIFIER Bulletin #100
SMALL LINE TYPE PURIFIER Bulletin #500
ANDERSON Hi-eF PURIFIERS
MADE BY THE MAKERS OF SUPER-SILVERTOP STEAM TRAPS AND STRAINERS

PURIFIER DIVISION,
THE V. D. ANDERSON COMPANY
1934 West 96th Street • Cleveland 2, Ohio

Gentlemen: Please send additional information on Anderson Hi-eF Purifiers described in:

☐ Bulletin #100 ☐ Bulletin #300 ☐ Bulletin #500
☐ Bulletin #200 ☐ Bulletin #400

Name .....
Company .....
Address .....
City ..... Zone .... State .....

NOTES FROM THE PUMP ENGINEER'S HANDBOOK

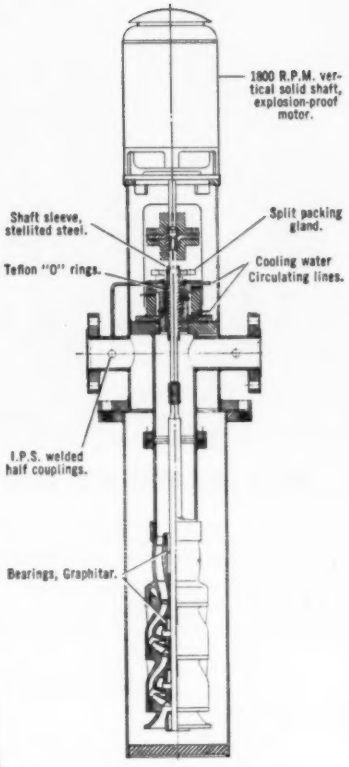
Little Details Like the XXX Seal Make Johnston Pumps Better!

Johnston pump bowl assemblies fitted with enclosed impellers have the Johnston XXX Seal—just another small detail that makes each Johnston the pump with real inside qualities. The design of the Johnston Seal, formed by the impeller shroud and the wear ring, provides sealing surfaces which prevent *any loss of efficiency* caused by liquid by-passing.

The extra hardness of the renewable aluminum bronze wear ring over standard bronze construction gives added protection, longer life and higher *sustained* pump efficiency. This is just one of the many little inside quality features that make each Johnston Pump better.

Every Johnston Pump is engineered for the specific duty for which it is intended. Trained hydraulic engineers are available at your nearest Johnston Dealer or at the Johnston factory to furnish detailed information, proposals and anything else necessary to meet your particular pumping equipment needs. Compare the inside qualities of Johnston Pumps and you'll never buy any other!!!

Sizes from 4 to 32 inches; single- or multi-stage; 2 to 1000 H.P.; capacities to 10,000 G.P.M.; lifts to 1000 feet; for liquid temperatures to 400° F.



SPECIAL DUTY PUMP FOR CONDENSATE RETURN

Due to the extremely high temperatures and pressures, the packing box has always been the vital point of a pump in condensate service. The gland on this unit was designed for 366° F. against a boiler pressure of 125 p.s.i. and is typical of the specialized equipment designed and furnished by Johnston engineers. A study of the customer's requirements indicated a NPSH of 3 feet. Actually this vertical pump unit required only a NPSH of zero at centerline of suction.

JOHNSTON PUMP COMPANY
3272 EAST FOOTHILL BLVD., PASADENA 8, CALIFORNIA

JOHNSTON VERTICAL PUMPS

HEADQUARTERS FOR VERTICAL TURBINE, MIXFLOW AND PROPELLER PUMPS SINCE 1909

just this

We design and manufacture "*every type and size*" of Speed Reducer and Gear. . . . This fact is important: (1) It assures the purchaser of our "unbiased" recommendations; (2) Permits ordering from "one source" of supply; (3) Enables the purchaser to place the *responsibility* for the operation of their Speed Reducers and Gears upon the shoulders of "one manufacturer".

Today, "Phillie Gear" has one of the largest and most modernly equipped gear plants in the country. Your inquiries are invited for information on any type of Gear or Gear Driven Product, which, of course, includes the widely used "*LimiTorque*" *Valve Control.*

For catalog on any product, please use your Business Letterhead when requesting same.

Herringbone Reducer

Philadelphia GearMotoR

Spiral-Bevel Reducer

Worm Reducer

Planetary Reducer

Spur Gear

Vertical Worm Reducer

Vertical Motor Reducer

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

A pressure gauge on a boiler or tank may seem small and unimportant, but have you ever stopped to think what a big part of your plant's efficiency and safety rests squarely on the verdict of the pressure gauge?

Actually it's just about the biggest thing on the boiler or any other pressure equipment. The maximum working pressure of any important equipment was tested by a pressure gauge: if the gauge was wrong the test was wrong. In service, the pressure gauge guides operation: if the gauge is wrong efficiency suffers and safety is imperiled.

Fortunately, manufacturers of quality equipment realize the danger of placing good equipment at the mercy of poor gauges. That is why you find Marsh gauges on the leading makes of boilers, compressors, pumps, hydraulic equipment and food processing equipment. Look around your plant and you will see how true this is. Most significant of all you will find that Marsh Gauges are used by the leading manufacturers of controlling equipment — the manufacturers who know instruments best.

Always remember that you can't see the condition; you can only see the indication of it shown by a pressure gauge. For such a vital function only the best is good enough — and that means MARSH.

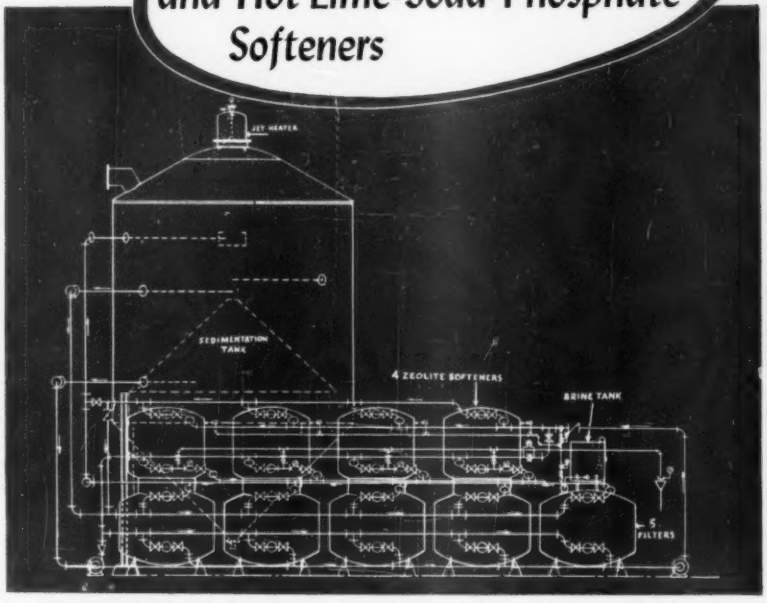
MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation* DEPT. F, SKOKIE, ILL.
Export Dept., 155 E. 44th St., New York, N. Y.

"THE STANDARD OF ACCURACY"

MARSH GAUGES

Cochrane HOT Lime ZEOLITE Water Softener

A Suggestion for Operators of Hot Lime-Soda and Hot Lime-Soda-Phosphate Softeners



The installation at the right shows a Cochrane Hot Lime-Zeolite Softener in a paper mill in the Northwest. The Zeolite Softeners are mounted on and supported by the filters in order to save space.

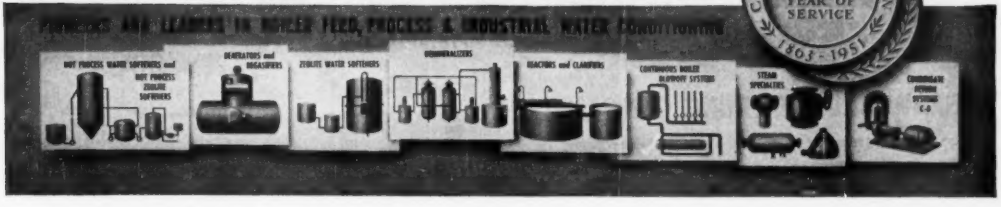
The introduction of Cochrane Hot Lime-Hot Zeolite Softeners presents an exceptional opportunity for increased capacity, with surprising savings in cost, to operators of conventional Hot Process Softeners who may be faced with expansion problems suddenly thrust upon them by today's production requirements. The conversion to Hot Lime-Hot Zeolite can be accomplished, in the case of Hot Lime-Soda Softeners by merely adding another settling tank to the existing settling tank, adding more filters, followed by a booster pump station discharging through a battery of Zeolite Softeners. In the case of two-stage softeners, the Hot Phosphate Tank is eliminated or may be used to double the first stage lime tank's capacity. More filters and a battery of Hot Zeolite units are added.

Cochrane Hot Lime-Zeolite Softeners are being installed in many expanding industries in all parts of the country.

COCHRANE CORPORATION • 3106 N. 17th St. • Philadelphia 32, Pa.

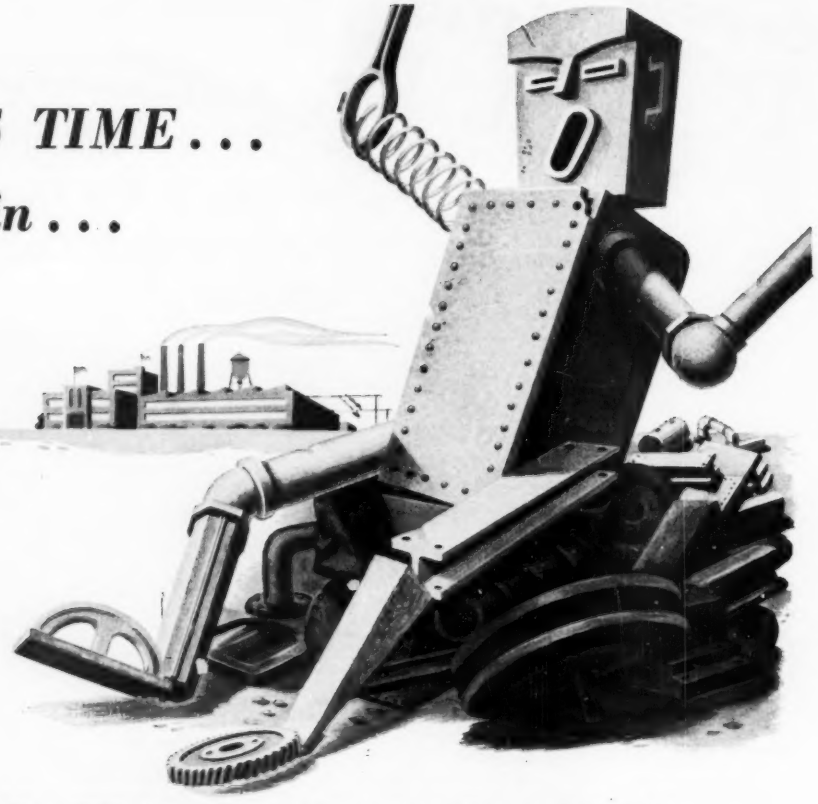
In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City • In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE



IT'S TIME . . .

again . . .



TO WAKE UP SCRAPPY!

Scrap's getting scarce again . . . compared to the amounts we need . . . and it's up to *all* of us to *help* produce enough steel.

107,000,000 tons of steel is the present rate of production in 1951 . . . 119,500,000 tons is expected in 1952.

Last year, 1950, we produced 97,800,000 tons.

All that extra steel—enough to take care of *both* military and civilian needs—calls for *more scrap iron and steel.*

Scrap Inventories Are Alarmingly Low

While steel mills are producing at a greater rate than ever, scrap inventories have dwindled. Many mills are operating on a hand-to-mouth basis with shut-downs threatened unless we furnish more scrap.

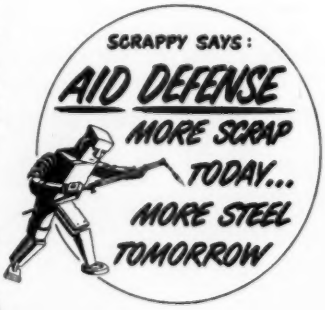
We *do* have the scrap. It's everywhere, not just in the form of *production* scrap—the "leavings" of machining, normally turned over to scrap dealers . . . but also in the form of *idle* metal: obsolete machines and tools, no-longer-usable jigs and fixtures, gears, chains, pulleys, valves, pipe, abandoned steel structures, etc.

We must have this *idle* metal to keep the furnaces running.

Please cooperate. Set up a Scrap Salvage Program in your plant—*now.* For a complete plan on "how to do it", write for booklet "Top Management: Your Program for Emergency Scrap Recovery". Address Advertising Council, 25 W. 45 Street, New York 19, N. Y.

Why Do We Need *Scrap?*

Steel is made half from pig iron, half from scrap. With production on the increase, more scrap must be purchased. And it's up to you to "dig it out" and sell it.



NON-FERROUS SCRAP IS NEEDED, TOO!

This advertisement is a contribution, in the national interest, by

McGRAW-HILL PUBLISHING COMPANY, INC.

330 WEST 42nd STREET **NEW YORK 18, N. Y.**

A PUBLIC SERVICE PROJECT THE ADVERTISING COUNCIL

WELDING FITTINGS ON YOUR MIND

It will pay you to think of Midwest whenever you think of welding fittings. For example: the variety of elbows offered only by Midwest provides greater latitude in piping design and permits improvements and economies not otherwise possible.

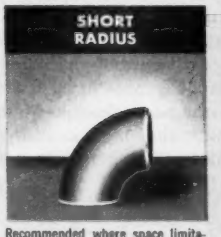
MIDWEST "LONG TANGENT"

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

ASA STANDARD

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Tolerances much less than allowable. Sizes to 26".

SHORT RADIUS



Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 30".

MIDWEST REDUCING

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

4580

MIDWEST
PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices: New York 7—30 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—320 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—324 Wright Bldg. • Boston 27—426 First St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

The 1522 *Challenges Comparison*

...Where else **can you find so many efficiency features in one pump!**

Measure the B & G Series 1522 Pump by any standards you choose . . . you'll say you've never before seen so many warranties of performance in a single unit.

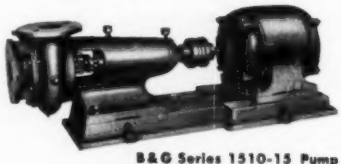
The B & G Leak-proof Seal alone establishes this pump as the "buy" for centrifugal pump applications. The Seal is self-lubricating and eliminates the usual leakage through the packing gland—assures long, trouble-free service.

It's a quiet pump. Long bronze sleeve bearings hold the shaft in alignment and the spring-type flexible coupling helps keep noise at a minimum. The impeller is hydraulically balanced . . . highly efficient.

Bearing bracket sub-assembly, including shaft and sleeve bearings, is interchangeable in all B & G 1522 Pumps. Easily serviced—the pump separates into three parts.

The B & G 1522 is available in all-iron, bronze-fitted, all-bronze or stainless steel units. Capacities to 130 GPM —heads to 115 ft.

B&G Series 1531 Pump
Leak-proof mechanical seal. Capacities to 1200 GPM —heads to 320 ft.



B&G Series 1510-15 Pump
Flexible-coupled. Capacities to 1200 GPM—heads to 320 ft.

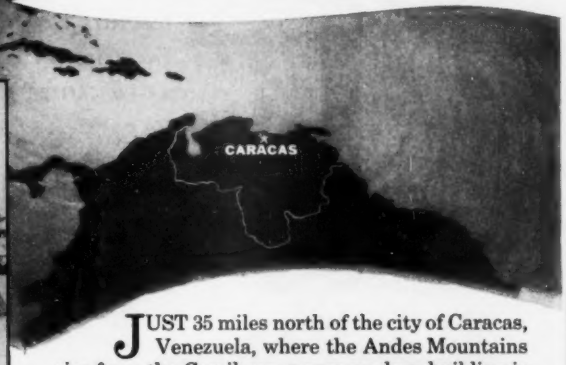
BELL & GOSSETT
COMPANY

Dept. CH-36, Morton Grove, Ill.

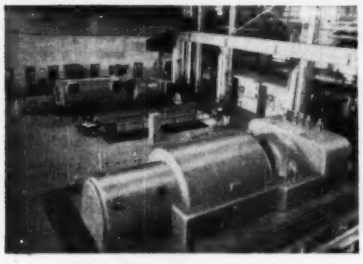
Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto, Canada

More Power to South America

from Pritchard



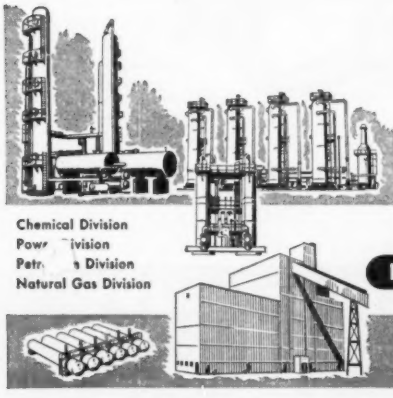
JUST 35 miles north of the city of Caracas, Venezuela, where the Andes Mountains rise from the Carribean, a new, modern building is nestled in a small valley on the seacoast. This building contains a *40,000 kilowatt* steam electric power station which ties into the distribution system serving the industrial and residential needs of the Federal District of Venezuela.



Interior of the 40,000 kw. steam electric power station designed and built by J. F. Pritchard & Co. near Caracas, Venezuela.

Designed, engineered and constructed by Pritchard, the Arrecifes Power Station of C.A., La Electricidad de Caracas, has boilers, turbines and all auxiliary equipment arranged for unit system operation without cross connection. This installation is another fine example of the many outstanding Pritchard-built plants that are providing maximum efficiency at lowest cost.

Whether *your* need is for a complete new plant, alterations or expansion, Pritchard provides the sound design, engineering and construction services that pay off in operational efficiency and trouble-free service. Your inquiry is invited.



Chemical Division
Power Division
Petro[illegible] Division
Natural Gas Division

For Complete Information, Write

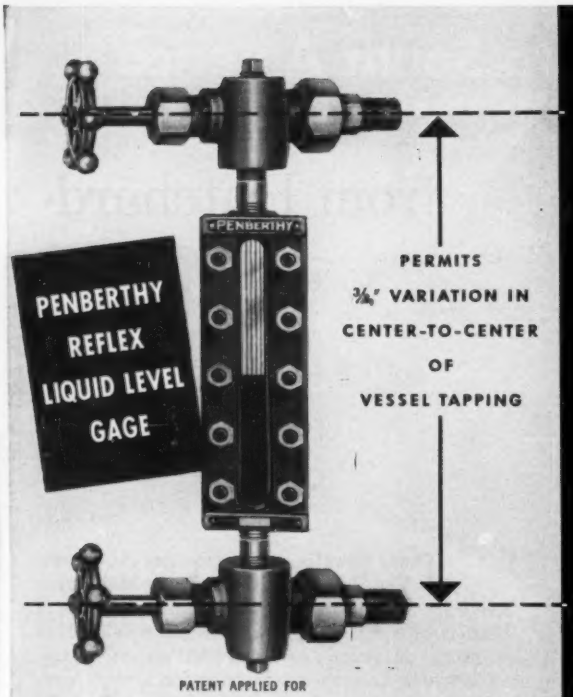
NATIONAL CONSTRUCTION ASSOCIATION — MEMBER

J.F. Pritchard & Co.

DESIGN • ENGINEERING • CONSTRUCTION

Dept. No. 211 — 908 Grand Ave., Kansas City 6, Mo.

District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast



PATENT APPLIED FOR

Another PENBERTHY First

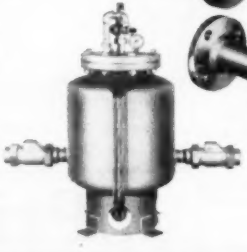
PENBERTHY "Floating Shank" *Saves Time and Money* in Gage Installation

A feature available only on Penberthy drop forged steel (and alloy) gage valves, the "floating shank" automatically compensates for as much as 3/16" variation in the center-to-center distance of the vessel tapping. This saves time and cuts the cost of gage installation . . . eliminates stresses often induced during mounting. Penberthy "floating shank" is available at slight additional cost. It will pay you well to specify "floating shank" on your next gage order.

OTHER PENBERTHY PRODUCTS

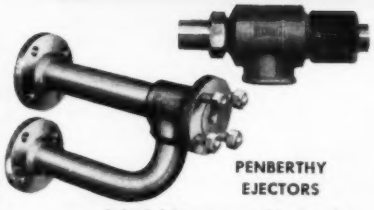
PENBERTHY TRANSPARENT GAGE

Used to observe color and density of liquids under high pressures and/or temperatures. Exceptionally sturdy construction—liquid chamber machined from solid block of metal. Ask for Catalog 35.



PENBERTHY CYCLING JET PUMPS

Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.



PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Made in wide variety of materials and special units developed to meet unusual conditions. Ask for Bulletin 512.

4671

PENBERTHY INJECTOR COMPANY

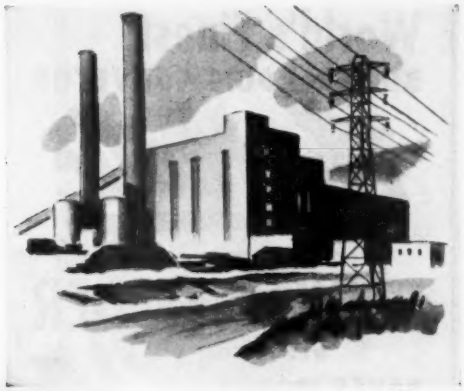
DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

DETROIT 2, MICHIGAN

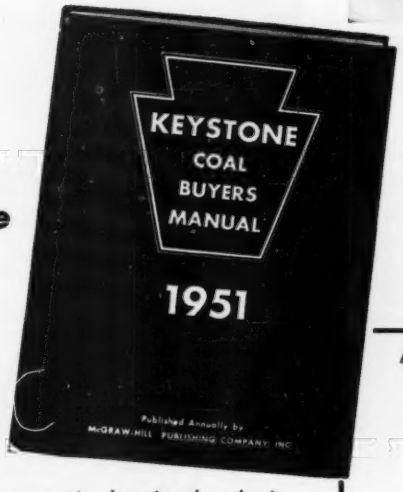
Established 1886 — *Canadian Plant, Windsor, Ontario*

MORE PRODUCTION
MORE EFFICIENCY
LOWER POWER COSTS

without additional capital outlay



By using the



PRICE $20.00

HELPS YOU BUY THE BEST COAL FOR YOUR PLANT

AMONG THE NATION'S TOP FUEL BUYERS USING KEYSTONE ARE:

Aluminum Ore	Container Corporation
American Brass	Consumers Power
American Gas & Electric	Consol. Gas El. L. & P.
American Steel & Wire	Dairymen's League
American Sugar Refining	Detroit Edison
American Woolen	Dow Chemical
Anchor Hocking Glass	Duke Power
Bethlehem Steel	DuPont
Burlington Mills	Ecusta Paper
Philip Carey	Escanaba Paper
Champion Paper	Evansville Corn Products
Chevrolet	Fisher Body
Chrysler	General Electric
Commercial Gas	General Foods
Consolidated Edison	General Refractories
Cone Mills	Giant Portland Cement
Commonwealth Edison	Great Lakes Carbon
Consolidated Cement	Great Lakes Steel
	Jamestown Industries

Plus National, State and City Fuel Buyers
Plus Army, Navy AEC, TVA, etc.

KEYSTONE is the recognized national authority for coal data—who mines coal—where, what kind, how much—reserves—sizes; how cleaned, dried—sizes shipped—percent ash, moisture, fusion, sulphur, volatile—how mined, how shipped—who sells it; and many other important details.

You can increase production and efficiency and lower power costs by using this authentic information to make sure you procure the very best available coal "buy" for your plant.

Hundreds of the Nation's top coal buyers use KEYSTONE daily to verify details of offers, to help evaluate bids and as a factual base for discussing coal problems, immediate or long-range.

These men refer to KEYSTONE as "The Coal Man's Bible." You too, can profit by daily use of the authentic information contained in its more than 600 pages.

- **FILL IN AND MAIL THE COUPON NOW!**

So that you, too, can begin to enjoy the possession of authentic detailed coal data.

KEYSTONE COAL BUYERS MANUAL
330 West 42nd Street, New York 18, N. Y.

Please mail me ..... copies of "KEYSTONE" and bill

Name .....

Title .....

Company .....

Address .....

A McGRAW-HILL PUBLICATION

World's Finest
BOILER ROOM CONVEYOR

Flo-Matic

WITHOUT EQUAL

SLOW SPEED INDUSTRIAL

STOKER FEEDER

REFUSE OR COAL

SAVES MONEY
Pays for itself

REQUIRES MINIMUM POWER TO OPERATE

- **SAVES HANDLING OF FUELS**
- **SAVES WORK**
- **FREES BOILER ROOM ATTENDANT FOR OTHER DUTIES**

Flo-Matic 16 ft. Slow Speed Screw Conveyor. Ruggedly built, smooth and efficient. Will deliver up to 500 B.H.P. of wood chips, hogged wood, sawdust or coal. Easily adaptable to most boiler rooms. Can be used in connection with your present stoker. Variable speed drive—extra.

ORDER **Flo-Matic** STOKER FEEDER NOW!

write conveyor division

AMERICAN COAL BURNER CO.

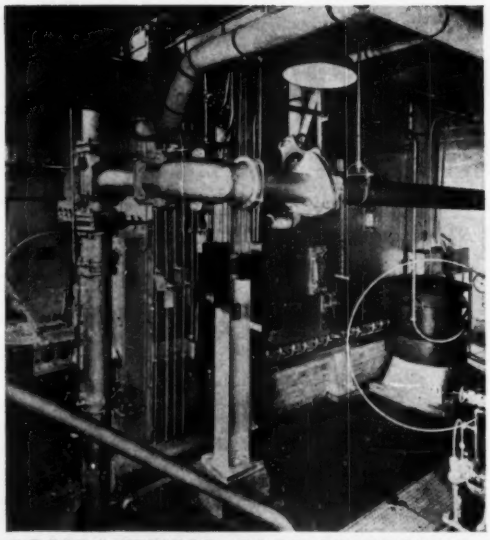
18-R EAST ERIE ST. CHICAGO 11, ILLINOIS

REFUSE OR COAL SPRAY SPREAD STOKERS

Manufacturers—Engineers Since 1899

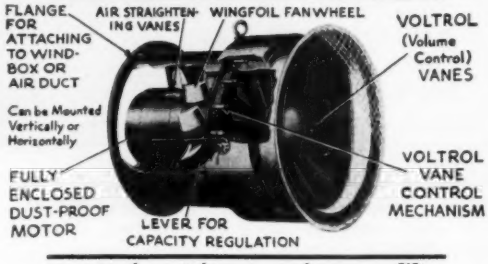
AGENTS—SALESMEN—DISTRIBUTORS

calling on boiler rooms can add to their income by selling the Slow Speed FLO-MATIC Conveyor. Every boiler room using solid fuels needs this Conveyor and is a prospect for this low cost Conveyor. Write for details.



COMPACTNESS, EASE OF REGULATION, LOW MAINTENANCE—IN THE WING AXIAL FLOW BLOWER

WING AXIAL FLOW BLOWERS are used on many of the country's leading makes of boilers as standard equipment. The reason lies in the


FLANGE FOR ATTACHING TO WIND-BOX OR AIR DUCT
AIR STRAIGHTENING VANES
WINGFOIL FAN WHEEL
VOLTROL (Volume Control) VANES
Can be Mounted Vertically or Horizontally
FULLY ENCLOSED DUST-PROOF MOTOR
LEVER FOR CAPACITY REGULATION
VOLTROL VANE CONTROL MECHANISM

consistently satisfactory performance Wing Blowers have been delivering for over half-a-century—plus many superior features of Wing design, such as the volume control (Voltrol) vanes, permitting capacity regulation down to 10% of maximum. Write for complete details and latest bulletin.

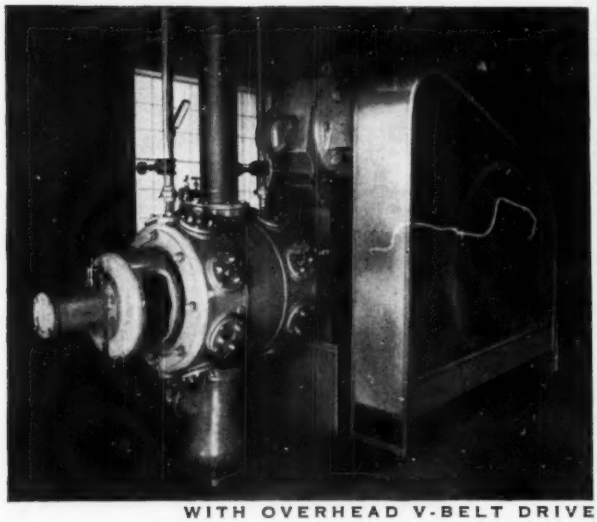
L. J. Wing Mfg. Co. 50 Vreeland Mills Road Linden, New Jersey

Offices in Principal Cities

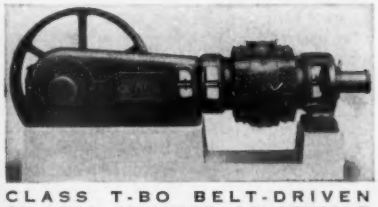
Wing

AXIAL FLOW BLOWERS

AIR FREE FROM OIL



WITH OVERHEAD V-BELT DRIVE



CLASS T-BO BELT-DRIVEN
OIL-LESS CYLINDER COMPRESSOR

Since no oil, grease or other cylinder lubricant is required in CP OIL-LESS CYLINDER COMPRESSORS, they are ideal where it is essential that compressed air be absolutely free from oil to avoid injury to products.

Piston and rod, completely supported by tail rod and outboard crosshead, are full floating, removing all weight from cylinder wall and stuffing boxes. This assures long life of segmented carbon piston rings, with no need for periodically rotating them.

CP OIL-LESS CYLINDER COMPRESSORS are available in a wide range of sizes and ratings; in single and two-stage types; arranged for belt, motor or steam drive.

WRITE FOR BULLETIN 728-8

CHICAGO PNEUMATIC TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

BOILER SCALE MEANS TROUBLE

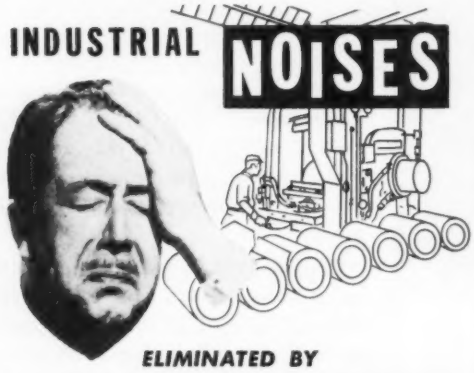
Butler water conditioning unit will prevent scale and corrosion and remove old scale in your boilers, hot water tanks and associated pipe systems and fittings, giving you more efficient operation and saving you countless dollars.

BUTLER
Engineering Co.
2612 ROUSSEAU ST
NEW ORLEANS, LA.

Illustrated Model EZ-B for high and low pressure fire tube and water tube boilers.

There's a Butler DeScaler to solve your water conditioning problem from automobiles to ships including trucks, buses, Diesel Engines, evaporators, sterilizers, etc. Write for complete information.

INDUSTRIAL NOISES



ELIMINATED BY

INDUSTRIAL ACOUSTICS COMPANY

Noise Elimination raises employee morale, increases productivity, builds good-will!

SCIENTIFIC NOISE CONTROL

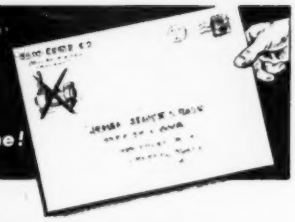
SILENCES disturbing noises from —

Power Plants • Boiler Rooms • Machinery • Stacks
Air Intake & Exhaust Systems • Power Generators
Transformers • Fans • Compressors • Cooling Towers
Vacuum Pumps • Air Conditioning Systems
and many others

Improved Efficiency • Employee Morale • Public Relations
Write today for complete information

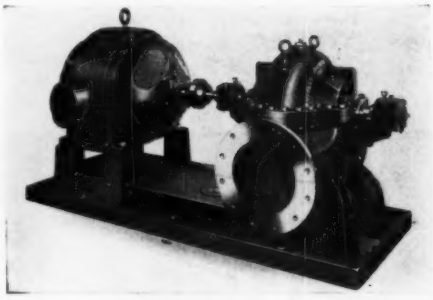
INDUSTRIAL ACOUSTICS COMPANY
333 JACKSON AVENUE, NEW YORK 54, N. Y. • CYPRESS 2-2722

The "LOW-BID" PUMP isn't necessarily the economical one!

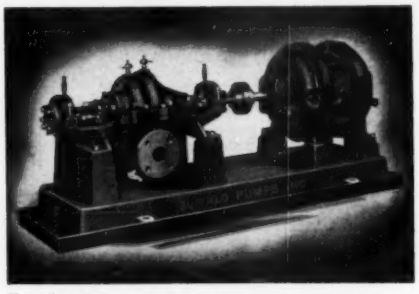


"Buffalo" PUMPS

Save Money on the Job — WHERE SAVING COUNTS!



Above, for handling clear water, 10 to 10,000 gpm, you can't beat a "Buffalo" Type "SL" Pump.



For clear water, any temperature, at pressures up to 500 pounds, specify a "Buffalo" Type "RR" Pump.

If the pump has been built down to a price rather than up to a quality standard, chances are that any savings on first cost will be nullified by continual repair and replacement costs. "Buffalo" Pumps have always been built to save your maintenance men trouble, to keep delivering for a maximum number of years and to use minimum power.

But why not get the construction and performance facts? Write today for Bulletins 955-N and 980-B, and see why "Buffalo" Pumps save money the minute they start on the job.

"Buffalo" PUMPS

BUFFALO PUMPS INC.
488 BROADWAY BUFFALO, NEW YORK
Canada Pumps Ltd., Kitchener, Ont.

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

...easier and better the WeldELL way

For the *practical* facts about pipe welding fittings go to the *practical* men...the welding foreman; the pipe fitter foreman; the construction superintendent... who have used all kinds and know the field.

They will tell you that the job moves faster and costs stay down when WeldELLS and other Taylor Forge fittings are used

...because of the precision quarter markings, the sized end tangents, the accurate machine tool bevels and lands.

They will tell you that the job maintains momentum easier, smoother

...because of the completeness of the line and better identification markings.

They can tell you...at least, design men will...that the *finished* job is better

...because it is done with fittings that are engineered down to the last detail to meet all requirements of *every job*.

Yes, "WeldELLS have everything"...to make it *easier ...better*. Coupon brings lots of facts.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS • *General Offices & Works:* Chicago 90, Ill. (P.O. Box 485). *Eastern Plant:* Carnegie, Pa. *Western Plant:* Fontana, Calif. *District Offices:* New York: 50 Church Street. Philadelphia: Broad Street Station Bldg. Pittsburgh: First National Bank Bldg. Chicago District Sales: 208 S. LaSalle Street. Houston: City National Bank Bldg. Los Angeles: Subway Terminal Bldg. San Francisco: Russ Bldg.

Please send a copy of your welding fittings and forged steel flange catalog 484

Name_____

Position_____

Company _____

Street Address_____

City_____ Zone____ State_____

Mail to Taylor Forge & Pipe Works
P.O. Box 485, Chicago 90, Ill. 501-1251

"GUNITING" with Super ADACHROME-CAST

..SAVES OUTAGE TIME and MONEY

Use SUPER ADACHROME-CAST to gunite your stud tube water walls,—Fine-grained to penetrate the small apertures between studs,—packs to a dense mass when shot. One user reports SUPER ADACHROME-CAST lasted twice as long and took but one-third the time to apply as compared with a plastic chrome ore installation.

Excellent for coating brickwork when free of slag.

BOTFIELD

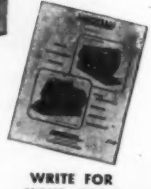
Yours, FREE for the asking . . . an illustrated, detailed Bulletin on Super ADACHROME-CAST.

REFRACTORIES CO.

784 S. Swanson St., Philadelphia 47, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

MODERNIZE with the AMESTEAM GENERATOR

HERE ARE THE FACTS!



• COMPLETE • COMPACT
• ACCESSIBLE • EFFICIENT
• AUTOMATIC

10 to 500 h.p.—
15 to 200 lbs.

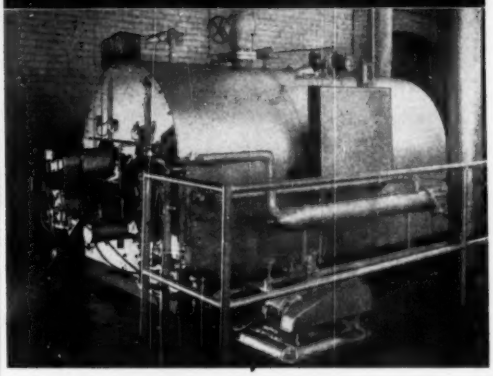
WRITE FOR YOUR COPY

AMES IRON WORKS

BOX 2712 OSWEGO, N. Y.

Builders of Better Boilers since 1848
Manufactured under
License in Canada by VOLCANO, Ltd., Montreal, P.Q.

This 100 H.P. Dutton EconoTHERM SAVES $20 PER DAY!



That's on fuel alone, reports McInerney Spring & Wire Co., of Grand Rapids, Michigan

How can *you* save on steam generation costs? Consider this case: During winter, McInerney operates two 300 H.P. boilers for processing and heating. From spring to fall, one boiler supplied processing steam only.

Two years ago, analysis showed that one 100 H.P. oil-fired EconoTHERM would provide plenty of steam for processing. After this "packaged" unit was installed, *over $20 per day savings on fuel alone resulted* — throughout five to six months each year!

Labor costs also dropped astonishingly. Because the EconoTHERM is automatically operated, a few hours per week suffice to check the boiler, burner and controls. Formerly, a full-time attendant was needed. McInerney was "highly pleased" — and we're confident you'll be equally pleased with EconoTHERM performance!

Your case may be very different

. . . yet Dutton may help you discover some highly important savings! Find out why the EconoTHERM's exclusive off-center firing gives you faster steaming — greater safety — and lower cost.

WRITE NOW FOR ECONOTHERM BULLETIN EC-100C

Other types and sizes — 5 to 250 h.p.
See Yellow Pages in Phone Book for Dutton Representative

Dutton BOILER DIVISION
HAPMAN-DUTTON COMPANY
KALAMAZOO • MICHIGAN
Boiler Makers Since 1880

Are You Still Paying Installments On Equipment You Already Own?

When you've got the receipt, equipment's supposed to be yours. Yet many operators go right on paying "installments" . . . in heavy maintenance, high operating costs, production lags.

This sounds like the granddaddy of all blind alleys. Yet consider what *one* power station did:

Faced with "rat-holing" and high maintenance costs, this company solved *its* problem with a 1400-ton bunker, using monel-clad steel for the bottom six feet of the four bunker noses. This solved corrosion and abrasion threats, assured surface smoothness, ended packing of moist fines that lead to "arching" and "rat-holing".

RESULTS: steady feed, without vibrators or a stand-by man . . . smoother flow to direct-firing pulverizers . . . lower operating costs.

What makes this story significant is that it resulted from a progressive planning method followed by certain Equipment Builders.

This method coordinates the knowledge of leading engineers, designers, and materials suppliers. Each factor affecting performance is *thought out by a specialist in that field.* In such planning, you'll find these builders turning to Lukens for its knowledge of materials, as well as its wide range of low cost clad steels.

Even with new equipment hard to get, we know builders who often can help you get more profitable performance from what you have. For their names, write us today, explaining your need. Manager, Marketing Service, 585 Lukens Building, Coatesville, Pennsylvania.

LUKENS

LUKENS STEEL COMPANY

WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PLATE • PLATE SHAPES • HEADS • CLAD STEELS

Get practical help from these McGRAW-HILL BOOKS

HEATING DESIGN AND PRACTICE

Just Published!

1. **Provides practical methods for effective design, and operation of steam, hot water, and warm air heating systems.** Gives data on radiant heating, the heat pump, baseboard units, space heaters, etc. Such components as boilers, steam generators, grates, stokers, and chimneys are thoroughly treated. Includes a section on fuels to help in better selection and use of combustion equipment. **By Robert H. Emerick, Consulting Engin. 483 pp., 224 illus., $8.00**

FUELS AND COMBUSTION HANDBOOK

2. **Presents comprehensive data covering the full range of commercial fuels and their combustion.** Gives practical aid in the selection and use of fuels and all types of fuel combustion equipment. Applies rapid computation technique of alignment charts and uses comparative tables to show advantages, disadvantages, average performance data, of optional equipment and methods. **Edited by Allen J. Johnson, Cons. Eng., and George H. Auth, Villanova Coll. 915 pp., 403 illus., $12.50.** (Available on easy terms.)

STEAM PLANT OPERATION

3. **Offers much information to help you pass power plant engineer license examinations.** Explains advanced rules of stationary engineering—outlines tested methods of operating power plant equipment—and points out the responsibilities of the operating engineer relative to safe practices and efficient operation. Includes valuable lists of questions typical of those asked in license examinations. **By Everett B. Woodruff and H. B. Lammers. Second Edition. 543 pp., 264 illus., $7.00**

CORROSION: Causes and Prevention

3rd Edition—Just Published!

4. **Simple explanation of the mechanics of corrosion and practical methods of prevention.** Explains how corrosion prevention cuts waste—Kinds of corrosion, their nature and occurrence—how to prevent corrosion in various engineering fields—economic aspects of corrosion prevention. Third edition includes sections on biological influence and cathodic protection, and advances in practical preventives. **By Frank N. Speller, Corrosion Consultant. Third Edition. 864 pp., 181 illus., $10.00**

SEE THESE BOOKS 10 DAYS FREE

McGraw-Hill Book Co., 330 W. 42 St., NYC 18

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep plus a few cents for delivery, and return unwanted book(s) postpaid. (We pay for delivery if you remit with this coupon; same return privilege.)

- ☐ 1. Emerick—**HEATING DESIGN AND PRACTICE $8.00**
- ☐ 2. Johnson & Auth—**FUELS AND COMBUSTION HANDBOOK $12.50** (Payable $3.50 in 10 days and $3.00 monthly)
- ☐ 3. Woodruff & Lammers—**STEAM PLANT OPER. $7.00**
- ☐ 4. Speller—**CORROSION $10.00**

(Print)

Name .....

Address .....

City ..... Zone ..... State .....

Company .....

Position ..... P 12

This offer applies to U.S. only.

PROFESSIONAL SERVICES

AMERICAN CALIQUA COMPANY
CONSULTING ENGINEERS
HIGH TEMPERATURE WATER DISTRIBUTION SYSTEMS
Space Heating and Industrial Processing
District and Municipal Heating
Room 1903, 155 E. 44th St., NYC 17, N. Y.

FRED L. PEARSON
Reg. Mechanical & Electrical Engineer
Steam — Diesel Power Plants, Water Supply Sewage disposal, Heating, Air Conditioning, Electrical distribution systems. Design Construction and Supervision.
1237 Majestic Building Detroit 26, Michigan

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City, Mo. P. O. Box 7088
Cleveland, Ohio 1404 E. 9th St.

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
231 So. La Salle St. Chicago 4

CARNAHAN & THOMPSON
ENGINEERS
Mechanical and Electrical Consultants
320 Oklahoma Natural Building
Oklahoma City 2 Oklahoma

SANDERSON & PORTER
Engineers and Constructors
New York • Chicago • San Francisco

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Industrial and Utilities, Power Plant Design and Construction. Rehabilitation and Maintenance.
Steam — Diesel — Hydro — Sewage
Reports — Examinations — Laboratory
New York Reading, Pa. Philadelphia
Houston Washington

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

J. E. SIRRINE COMPANY
Engineers
Power Plants — Consultations
Design — Reports
Water — Steam Utilization — Plans
Greenville South Carolina

THE KULJIAN CORPORATION
Engineers • *Constructors*
1200 North Broad St., Philadelphia 21, Pa.
Washington, D. C.; Rome, Italy;
Calcutta, India; Caracas, Venezuela;
Mexico City, Mexico

STANLEY ENGINEERING COMPANY
Consulting Engineers
Power Plants
Steam - Diesel - Hydro
Design - Construction - Test - Valuation
Hershey Building Muscatine, Ia.

LARAMORE AND DOUGLASS, INC.
Consulting Engineers
POWER PLANTS
TRANSMISSION DISTRIBUTION
DESIGN—REPORTS—APPRAISALS—RATES
79 East Adams Street Chicago 3, Illinois

JOHN A. STEVENS, INC.
Established 1909
Consulting Engineers
Power Plants Paper Mills
Dye Houses Surveys
Lowell, Massachusetts

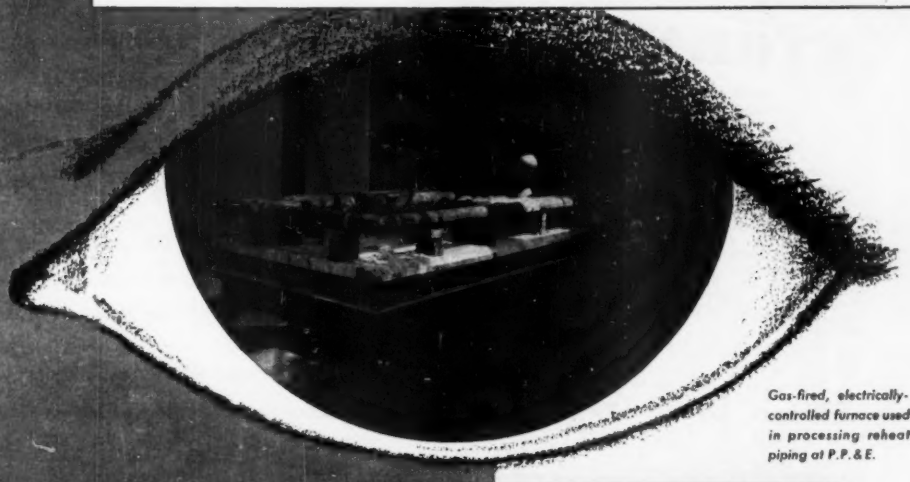
LUTZ AND MAY
Consulting Engineers
STEAM, GAS & DIESEL POWER STATIONS
PUMPING PLANTS — ELECTRIC SYSTEMS
REPORTS—DESIGN—APPRAISALS
1009 Baltimore Kansas City 6, Mo.

SYSKA & HENNESSY, INC.
Engineers
Consultation Plans Reports
Power Plants Disposal Plants
Water Systems
144 East 39th Street
New York, New York

MORAN ENGINEERS
Designers and Consultants
Buildings — Power Plants
Air Conditioning — Ventilation
30 Church St. — New York 7, N. Y.

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
30 Broad Street, New York 4

Looking at REHEAT



Gas-fired, electrically-controlled furnace used in processing reheat piping at P.P.&E.

Through Experienced Eyes

Proper piping is essential in order to realize the benefits inherent in reheating steam to higher temperatures—increased volume per pound of water evaporated . . . reduced condensation in lines, casings, cylinders, etc. . . . improved BTU output . . . better fuel economy.

Remember when 750° F. was thought to be a high reheat temperature? Even then P.P.&E. was ahead of the needs in piping that would carry the load. As the trend toward higher temperatures continued, P.P.&E.'s experience accumulated.

That's why the conditions encountered in present-day reheat temperatures over 1000° F. are thoroughly understood by P. P. & E. engineers—and why adequate materials, design know-how, methods of treating and fabricating, and testing procedures are available.

Look to Pittsburgh Piping and Equipment Company for the experience, and the leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

P. P. & E. Products

Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Valves
Expansion Bends	Welding Fittings
Flanges	Welded Assemblies

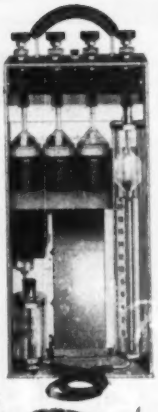
Pittsburgh Piping

AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston

TELLS the *Complete* STORY



This ELLISON PORTABLE GAS ANALYZER gives you the **complete** story of flue gas content . . . accurate readings for CO_2, O_2 and CO-plus a flue gas thermometer. In one easy-to-handle case you have a gas sampling tube, pipe adapter, two flue gas thermometers, two thermometer holders, and portable draft gage sets for your particular needs. The case is made of chemical-resistant monel metal. Case bottom has four studs for standing the analyzer on flat surfaces. Be sure of proper combustion.

WRITE FOR BULLETIN 120

SINCE 1896

Ellison Draft Gage Co.

217 W. KINZIE ST. CHICAGO 10, ILL.

THE ELLISON LINE ALSO INCLUDES:
Dial Draft Gages—Bell Type - Inclined Draft Gages—Portable Inclined Vertical Tube Gages - Vertical Tube Gages—Oil, Heavy Liquid and Mercury—Single and Multi-Tube - Saturator Gages U Gages—Stationary and Portable - Air Filter Gages—Dial and Inclined Tube Types - Pitot Tubes - U Path Steam Calorimeters—Portable Gas Analyzers

NOTICE

About Your Power Handbook

Reprints of the Power Handbook (Parts I and II) are available now. Your order can be promptly handled.

It contains 64 fact-filled pages, and the price of single copies is $1.00, slightly less for quantities of 100 and over.

Send your order for the complete Power Handbook to: Power, Reader Service Dept., 330 West 42nd St., New York 18, New York.

WHERE TO BUY

Featuring additional products specialties and services for power plants

CHIMNEYS

Industrial Waste Burners

AMERICAN CHIMNEY CORP.
141 Fourth Ave.
New York City

BRANCHES: BOSTON
PHILADELPHIA - BUFFALO
CLEVELAND - DETROIT

Ernst

- Refinery and Chemical Liquid Level Gages and Valves for All Kinds of Service
- Sight Flow Indicators
- Gage Glasses
- Gage Glass Gaskets

ERNST
WATER COLUMN & GAGE CO.
LIVINGSTON, N. J.

STICHT FOR TACHOMETERS

HERMAN H. STICHT CO., INC.
27 PARK PLACE N.Y.C.

"MONO"
BOILER BAFFLES
HIGH TEMPERATURE
Refractory Cements
SANFORD C. SMITH REFRACTORIES, INC.
1715 NIAGARA ST., BUFFALO, N. Y.

STERLING TRAPS
Return Traps—Lifting Traps
Vacuum Traps
Separating Traps
STERLING ENGINEERING & MANUFACTURING CORP.
TEMPLETON BROS.
110 Business Street
Hyde Park 36, Mass.

This WHERE TO BUY *Section*

supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical power operation and maintenance. Make a habit of checking this section, each issue.

Classified Advertising Division
POWER

NOTES for the Power Engineer

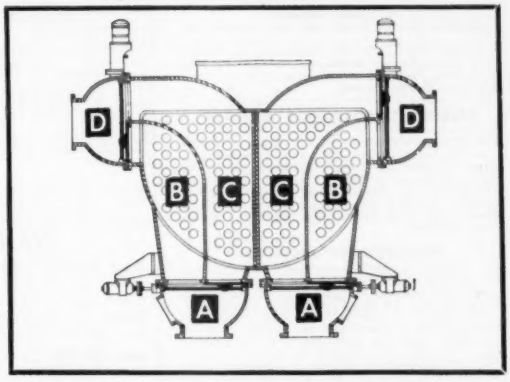
C.H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

"REVERSE FLOW" CONDENSERS

SOLVE YOUR CLEANING PROBLEMS—REDUCE OPERATING COSTS

These advantages are possible only in C. H. Wheeler's unique design of an integral reverse-flow steam condenser. By an arrangement of electrically or hydraulically controlled sluice gates, the flow of water through the condenser tubes is reversed. Refuse is rapidly and thoroughly flushed down the discharge in a matter of minutes, without shutdown of the unit. In addition to saving cleaning time and eliminating labor costs, you improve the efficiency of the whole unit by not reducing load. The need for expensive mechanical water straining apparatus is also eliminated. Reverse-Flow may be incorporated in either divided or non-divided water boxes.



Left Side: Flow is reversed: Valves at inlet D and discharge A are changed to permit water to flow through C and back through B in the opposite direction, then out through lower port of A.

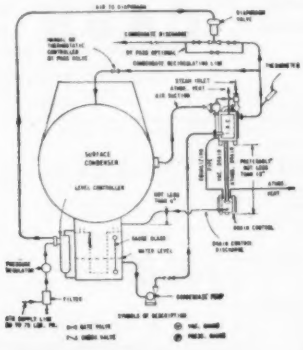
CROSS-SECTION DUAL BANK CONDENSER SHOWING HOW "REVERSE FLOW" WORKS

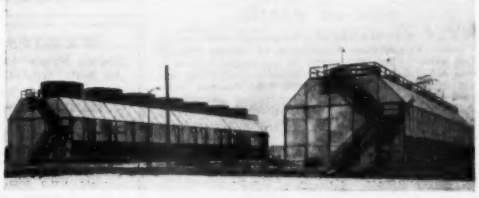
Both halves work the same but independently of each other.

Right Side: Water enters divided water box at valve chamber D, with lower port open. It flows through pass B to end of condenser, back through pass C and out through left port of A.

RECOMMENDED HOTWELL LEVEL CONTROL WITH TUBEJET AIR EJECTOR

This diagram is typical of the information awaiting you in Specification 88. This 4-page illustrated bulletin describes the improved steel shell Tubejet Air Ejectors with combined surface type inter-after condenser. Many power plant engineers are adopting this more reliable, space saving equipment for stationary power plant use. A request on your company letterhead will bring a copy of Specification 88 by return mail.





C. H. WHEELER COOLING TOWERS for MUNICIPAL POWER PROGRAM

Following construction of two 7-cell, 30,000 GPM cooling towers at the Leon Creek Power Station of San Antonio, Texas, C. H. Wheeler was awarded the construction of a third and larger tower. The new tower will handle 55,000 GPM to serve a 60,000 KW generator. It is a 13-cell induced-draft tower designed for 76.5° wet bulb, taking water at 105.5° inlet and cooling it to 90° outlet. Proposed construction is 39'8" x364'x29'. It will resist 30 lbs. per square inch wind pressure, or 100 mph hurricane force. Gibbs & Hill, New York, are the engineers and constructors on the job.

C. H. WHEELER MANUFACTURING CO. 1600 SEDGLEY AVE. PHILADELPHIA 32, PA.

Advertisement

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

(Not available for equipment advertising)
$1.20 a line, minimum 3 lines. To figure advance payment, count 5 average words as a line.

POSITION WANTED & INDIVIDUAL SELLING OPPORTUNITY, undisplayed advertising rate is one-half of above rate payable in advance. PROPOSALS, $1.20 a line an insertion.

INFORMATION

BOX NUMBERS count 1 line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

DISPLAYED RATE

The advertising rate is $13.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns — 30 inches—to a page.

NEW ADVERTISEMENTS received by Dec. 10th at the New York Office, 30 W. 42 St., N.Y. 36, will appear in the Jan. issue, subject to limitation of space available.

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

(Additional Position Vacant Ads on opposite page)

BOILER ERECTOR. Superintendent & Estimator to handle new division of Business for New York firm. State experience, salary desired, when available. P-2488, Power.

SELLING OPPORTUNITY OFFERED

MANUFACTURERS AGENT. Some exclusive territories available. "Ronningen" quick coupling non-short-circuiting water filters. 50 to 5000 GPM. Pressures to 200#. Excellent opportunity for engineering salesman handling pumping machinery or heavy industrial equipment. Liberal commission basis. Ronningen Mfg. Co., Vicksburg, Michigan.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500 to $35,000. We offer the original personal employment service (established 41 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered; present position protected. Ask for particulars. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONNEL $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

POSITION WANTED

STEAM MECHANICAL Engineer with eight years application experience of steam process and generating equipment in industrial and central station plants. Seven months operating experience. Well acquainted with heat balance work and general power plant operation. Graduate M.E. and registered in Pennsylvania and Ohio. Prefer East. Age 32. PW-2032, Power.

SELLING OPPORTUNITY WANTED

SALESMAN—METROPOLITAN N. Y.—looking for lines or position dealing with major oil, chemical, process accounts—pumps, valves, steam specialties, etc. SA-2481, Power.

PATENTS

Consult: Z. H. Polachek.
Reg. Patent Attorney, 1234 Broadway, New York 1, N. Y.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 526 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

New England Boiler Setting Co.
Specialists on
FIRE BRICK CONSTRUCTION
Industrial Furnaces
Expert Repairing
Stephen S. Donoghue
106 Webster St. Arlington 74, Mass.

TRADE WITH BAUER
BUY - SELL - TRADE
your
COMPRESSOR VACUUM PUMP STEAM BOOSTER
L.W.BAUER
245 ESSEX AVE BLOOMFIELD N.J.

WANTED

WANTED
Good used 200 or 300 KW Engine Generator Set AC 240 volts, 3 phase, 60 cycles, direct connected to vertical four cylinder Unaflow Steam Engine, 150# steam pressure, 5# back pressure.
Also, 200 KW, 3 wire, direct current generator 115/230 volts, with inter-pole windings, direct connected to vertical or horizontal Unaflow Steam Engine, designed for 125# steam pressure, 5# back pressure.
In first letter state age of machine, where located, and price. F.O.B. Cars. No JUNK Please.
BOX 296, GARDINER, MONTANA

WANTED
DIESEL ENGINE
900-1500 HP.
with or without Generator.
W-2463, POWER
330 W. 42nd St., New York 18, N. Y.

WANTED FOR CASH
Electric Motors—Starters, Transformers—Oil & Air Brkrs. Wire—Cable—Wiring Materials.
Send Listings
ALLIED ELECTRIC & MACHINERY CO.
1007 Falls Bldg., P. O. Box 1838
MEMPHIS 1, TENN.

We buy for cash
BOILERS
B&W Straight tube type
ARG CHEMICAL MACHINERY
POWER EQUIPMENT
P. O. BOX 2702, MEXICO CITY

BUYERS OF SURPLUS COPPER INSULATED WIRES AND CABLES
No lengths too long or too short
TELEPHONE: EASTGATE 7-4778
PIERCE CABLE CO.
2668 CLYBOURN AVE., CHICAGO 14, ILLINOIS

CASH FOR SURPLUS MOTORS
TRANSFORMERS, GENERATORS
See our ad on Page 300
ELECTRIC EQUIPMENT CO.
World's Largest Inventory
ROCHESTER, N. Y.

WANTED
HYDRO ELECTRIC UNIT
200 to 400 KW, 2400 volt, 60 cycle, 3 phase, to operate on 100 foot head.
PINEDALE POWER & LIGHT COMPANY INC.
PINEDALE, WYOMING

"SEARCHLIGHT"
IS
Opportunity Advertising
—to help you get what you want.
—to help you sell what you no longer need.
Take Advantage Of It
For Every Business Want
"Think SEARCHLIGHT FIRST"

WANTED
Motors, Generators, Transformers
Send us your lists and requirements.
BROMLEY ELECTRICAL ENGINEERING COMPANY
149 Broadway New York 6, N. Y.

ELECTRICAL
Chief Engineer

Chief Electrical Engineer, capable of supervising large electrical design division, required for permanent position in large industrial engineering firm located in the Midwest. Must be fully experienced technically, as well as administratively.

Submit complete record stating experience, education, salary required and availability. Interviews arranged with qualified applicants. All replies confidential.

P-2308, POWER
520 N. Michigan Ave., Chicago 11, Ill.

ENGINEERS

Chemical • Mechanical • Piping • Process

Long term openings in permanent offices located at Cleveland, Ohio and Frederick, Maryland offering good salary plus overtime (forty eight hour week) for qualified Engineers, Group Leaders and Designers experienced in one or more of the following phases of industrial plant design:

Process Piping
Instrumentation
Process Equipment Layout
Packaging
Air Conditioning
Plumbing
Tanks and Vessels
Boiler Houses
Plant Layout
Conveyors
Heating and Ventilation
Refrigeration
Sprinklers
Water Treatment

Limited number of openings for Estimators experienced in Mechanical and Chemical installations as well as building construction.

Also have a number of openings in our Cincinnati and New York City offices for similar type personnel.

Excellent working conditions with paid vacations, sick leave plan and participating Group Insurance Program.

Please submit complete resume stating experience, education, salary required and date available to:

THE H. K. FERGUSON COMPANY
Engineers and Builders
FERGUSON BUILDING — CLEVELAND 14, OHIO

ENGINEERING DRAFTSMAN and DESIGNERS

Experienced in Plant Layout, Process Piping, Power and Lighting Layouts, Structural Steel and Reinforced Concrete Design.

Submit Complete Resume—Education, Experience and salary expected.

The Solvay Process Division
ALLIED CHEMICAL & DYE CORP.
SYRACUSE 1, N. Y.

ENGINEERS
MECHANICAL and ELECTRICAL

Field Service, Design, and Estimating in the field of pneumatically and electrically operated controls.

Write to or see:

Mr. R. C. CIBELLA
HAGAN CORPORATION
323 Fourth Avenue
Pittsburgh 22, Pa.

Wanted
ENGINEERS AND SCIENTISTS

Unusual opportunities for outstanding and experienced men.

These top positions involve preliminary and production design in advanced military aircraft and special weapons, including guided missiles.

Immediate positions include:

- Weight-control engineers
- Electronic project engineers
- Electronic instrumentation engineers
- Radar engineers
- Flight test engineers
- Stress engineers
- Aero- and thermodynamicists
- Servo-mechanists
- Power plant installation designers
- Structural designers
- Electro-mechanical designers
- Electrical installation designers

Excellent location in Southern California. Generous allowance for travel expenses.

Write today for complete information on these essential, long-term positions. Please include resume of your experience & training. Address inquiry to Director of Engineering.

NORTHROP AIRCRAFT, INC.
1011 E. Broadway
Hawthorne (Los Angeles County), California

OPPORTUNITIES FOR ENGINEERS

Structural — Mechanical — Electrical — Process Engineers, Designers, and Draftsmen for power plant and paper mill jobs. Office in Southern Michigan.

Resident Engineer on a large paper and pulp mill expansion in Florida.

Excellent salaries. Write immediately, giving experience, education and personal data to

P-2435, POWER
520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL ENGINEER

For Large Eastern Utility

Outstanding opportunity for mechanical engineer about 35 with practical experience in modern steam station engineering, design and operation. Permanent location with a progressive and rapidly developing company.

Send full details

J. T. JENNINGS
241 ORANGE STREET
NEW HAVEN 10, CONN. (Agency)

MECHANICAL ENGINEER: Large industrial plant in northern New England requires graduate steam power plant engineer with sound theoretical training and experience in operation of 700,000 pound steam power equipment. Immediate position would be Assistant Steam Power Supervisor developing to Steam Power Supervisor. Please give full particulars in respect to professional and personal qualifications.

P-2459, POWER
330 W. 42 St., New York 36, N. Y.

When Answering
BOX NUMBERS . . .

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

WANTED: Experienced Power Station Engineer.
POSITION: Assistant to Manager of Power Production with administrative responsibility of operating central stations totaling approximately 800,000 kw.
LOCATION: Pennsylvania.
ADVANCEMENT: Excellent for growth on job and promotion in near future.
EXPERIENCE: 10 years minimum, with at least 5 years in operation, maintenance or efficiency work in large modern steam-electric central station. Construction and design experience will be considered.
EDUCATION: B.S. degree in Mechanical (preferred) or Electrical Engineering from an accredited engineering college.
AGE: 30-45.

Salary commensurate with qualifications.
All applications will be acknowledged.
Please send personal record to
P-2126, POWER
330 W. 42 St., New York 36, N. Y.

POWER SUPERINTENDENT WANTED

for large paper mill power plant located in the South. Must be experienced with high pressure boilers and process steam operations. In first letter give college background, experience, marital status, etc.

Write P.O. BOX 1844
SAVANNAH, GEORGIA

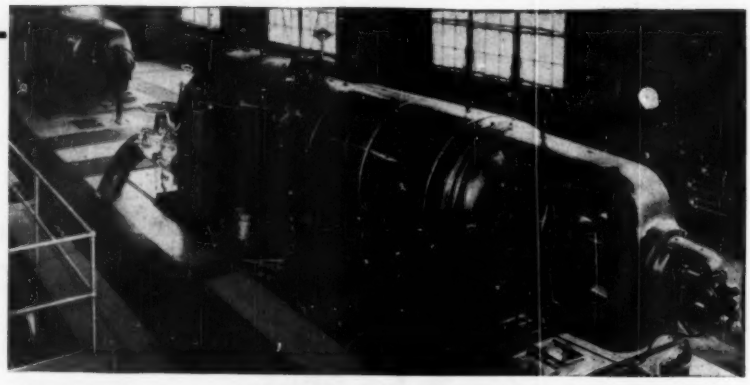
LOOK NO FARTHER

2500 KW. @ .80, 3125-KVA.

TWO (2) GENERAL ELECTRIC TURBO-GENERATORS

VERY HIGH GRADE UNITS : Are Duplicates

WILL PASS RIGID INSPECTION



Above View shows our Two (2) General Electric Turbo-Generators on present Foundations. They are 2500 KW @ 80% PF, 3125 KVA, both are complete units with (2) Surface Condensers, Exciters, and all auxiliaries. Steam 160/225# psig, 450° FTT, 2300, 4160, 6900 V.

BULLETIN #900 in Colors has specifications and Complete Data on above Units. SEND FOR IT TODAY.

A PARTIAL LIST OF TURBO-GENERATORS IN OUR STOCK IS GIVEN BELOW

12,500-KVA G.E., CONDENSING Complete A-1

6,250-KVA G.E., Complete Condensing Unit Condition: Excellent, 200# PSIG, 2300/4160 V. High Grade Unit

3,750-KVA G.E. 150/250# PSIG, 480 Volt Limited use since Rebuilt A-1

3,750-KVA G.E. modern 440# PSIG, 750° FTT 2300 Volt. Rare unit.

3,125-KVA 160/225# psig, 2300 Volt
See above Cut and description (2)

3,125-KVA G.E. 200# psig, 2300 V. OK

2,500-KVA G.E. 150/200# psig, 2300 V

2,500-KVA, Westg. 250/350# psig, 2300 Volt, Non-cond. Like New Unit. Back P. 40/50#. Modern. Any Insp.

1,875-KVA Allis-C, 150-200# psig 2300 V. Rebuilt by Allis Co.

1,875-KVA Allis-C, 150/250# psig 2300 V. Very Good

1,250-KVA, Allis-C, 200# psig. Rebuilt Excellent condition A-1

937-KVA G.E., 150# psig, 480 V Rebuilt

1,000-KVA 440# psig, 750° FTT, Condg. New, never uncrated G.E. 480 V

937-KVA Allis-C. 125/200# psig 480 V. Rebuilt, New Coils No. 1

625-KVA, Westg. 250# psig, Non-cond. 125#, B.P. Like New Machine

625-KVA, G.E., 125/175# psig 480 V A-1

WE OWN ALL ABOVE TURBINES. ARE IN STORAGE: IMMEDIATE DELIVERY

COMPLETE DATA IS IN OUR FILES: INSPECTION REPORTS, DRAWINGS, ETC. ARE YOURS FOR THE ASKING

WRITE,
WIRE OR
TELEPHONE

CHARLES WEAVER, Owner
ELECTRICAL AND MECHANICAL ENGINEERS
4145 PENOBSCOT BUILDING, DETROIT 26, MICHIGAN

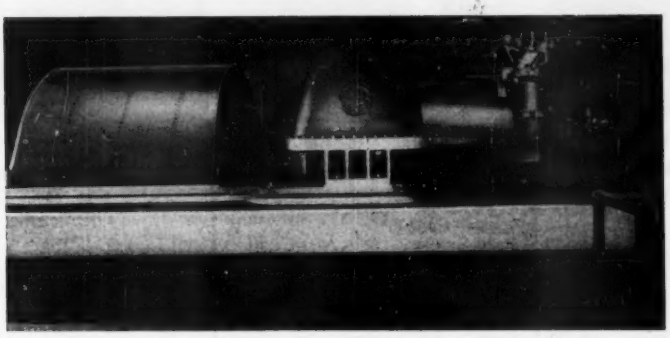
TELEPHONES:
WOODWARD 1-1340
WOODWARD 1-1341
WOODWARD 1-6038

GOOD EQUIPMENT • RIGHT PRICES • IMMEDIATE DELIVERIES

FOR TURBINE GENERATORS BOILERS, DIESEL POWER

3000 KW .80 3750-KVA. GENERAL ELECTRIC CONDENSING TURBO-GENERATOR

A MODERN HIGH PRESSURE HIGH TEMPERATURE UNIT



The above Reproduced Photograph Covers a Very Modern General Electric, Form GG., 14-Stage, 3000 KW @ 80% PF, 3750 KVA. Turbine-Generator, a design very seldom on the market. It is a 400# psig, 750° FTT, 3/60/2300/4160 volt, condensing, in excellent condition in every way. Is served by a Surface Condenser and is a complete installation. FULL DATA ON REQUEST.

OUR DECEMBER SPECIALS

2,500-KVA, Westinghouse Non-Condensing Turbo-Generator, Steam 250/400# psig, 40# Back P, 50# BP with changes 3/60/2300-V. Limited Service: Modern. Like a New Unit. Ask for Inspection Report.

6,250-KVA, General Electric Condensing Turbo-Generator, A complete Machine with Surface Condenser and all appurtenances. Steam 200# psig, 600° FTT, 3/60/2300-4160 Volt. Condition: Ready for installation with no repairs. Send for Inspection Report and Data.

Deliver Duty Free any point in USA or Canada. Investigate.

OFFERINGS FROM OUR STOCK ARE NOTED BELOW

BOILERS: B & W, 850# psig, 100,000# steam per hour. Combustion Engineering Co., 450# psig, 70,000# steam per hour. These Boilers are in excellent condition. Will pass rigid inspection. Immediate Delivery. Full data on request. Many other high grade Boilers available. Send us your specifications. Space does not permit listing them here.

TURBINE-GENERATORS: LARGE CAPACITIES: 25,000 KVA, G.E. 15,000 KVA, G.E., 12,500 KVA G.E. ALL condensing units, complete with all auxiliaries. We have complete data on file and will be pleased to forward it to any interested parties. Prompt investigation is suggested.

INVESTIGATION IS INVITED ON ALL OF THE ABOVE. ALSO ON TURBINES LISTED ON THE OPPOSITE PAGE. ALL GOOD MACHINES.

WRITE, WIRE OR TELEPHONE

CHARLES WEAVER, Owner
ELECTRICAL AND MECHANICAL ENGINEERS
4145 PENOBSCOT BUILDING, DETROIT 26, MICHIGAN

TELEPHONES:
WOODWARD 1-1340
WOODWARD 1-1341
WOODWARD 1-8038

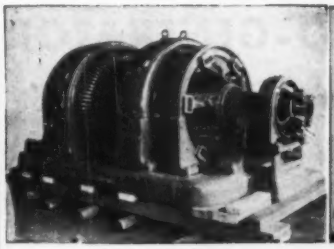
IT ISN'T RE-NU-BILT UNLESS

It Comes from

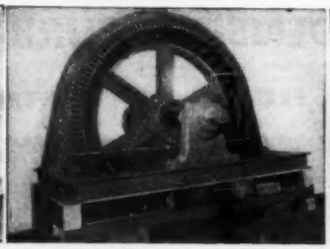
BELYEA

"SUCCESSFUL OPERATION GUARANTEED"

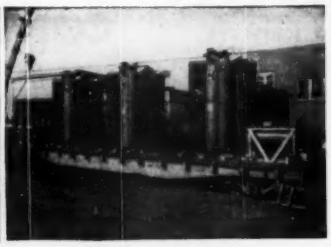
RECENT SHIPMENTS



1000 KW MG SET



1000 HP 189.5 RPM SYNCHRONOUS MOTOR



3—667 KVA TRANSFORMERS

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
2	2000*	G.E.	500		6600/11000
1	1500	G.E.	720	600	6600/13200
1	1500	Whse.	600	600	2300/4600
1	1500	G.E.	360	275	2200/4400
1	1000	G.E.	900	260	6600
1	1000(3U)	G.E.	900	250	2400/4800
2	500	Whse.	900	250	2400/13200
1	500	Whse.	1200	125/250	2300
1	500	G.E.	720	125	2300/4600
1	400	G.E.	720	250	440/2300
1	400	Whse.	1200	250	2300
1	400	G.E.	900	275	2300/4150
1	350	G.E.	900	125	2300/4150
1	340	G.E.	1200	250	2300
1	300	A.C.	1200	240	2300
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	900	125/250	2300
1	125	G.E.	1200	125	440
1	100	G.E.	1170	125	220
1	100	Delco	1200	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
6	70	G.E.	1200	70	220/440

*25 Cycle

ROTARY CONVERTERS

60 Cycles

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G.E.	514	600	13800
1	1000	Whse.	900	600	11000

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	6000	Al. Ch.	Condensing 200/250 ISP 2300/3/60-Exc. & Surface Cond.
1	2500	G.E.	Auto. Ext. Cond. 600 lbs.-800* F.T.T. 175/200 Auto. Ext. 2300/3/60 Exciter & Surface Cond.
2	1000	G.E.	Non condensing, 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
3	750	G.E.	Condensing 425#-725°TT ISP, 440 V-3 ph. 60 cy. New — 1944
1	625	Whse.	Non-condensing, 125/150# ISP 5/20# B.P., 480 v., 3 ph., 60 cy., with exciter
2	500	G.E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60
1	400	Whse.	Non-condensing 125/150# ISP 5/10# G.B.P. 240/480v. 3 ph. 60 cy.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V, 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V, D.C.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240 V. 3 ph. 60 cy.

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—2300	G.E.	MCF	600	350/500
1—1750	West.		600	525/720
1—1500	Whse.		525	600
1— 940	Whse.	QM-R. Brg.	250	140/170
1— 800/1000	Whse.		450	600/720
1— 600	Al. Ch.	MILL	230	400/800
2— 450	Whse.		550	415
1— 300/400	G.E.	DYNA	250	1325/2500
1— 350	Cr. Wh.	CCM-151H	230	1100
1— 325	Whse.	MQ	250	300/900
1— 200/300	G.E.	MPC	230	550/920
1— 250	G.E.	MPC	230	400/500
1— 150	G.E.		600	250/750
10— 150	Cr. Wh.	83H	230	890
1— 150	Cr. Wh.	CMC-65H	230	1150
1— 150	Whse.	SK-201	230	380/950
1— 50/120	G.E.	MFC	230	250/1000
2— 100	Whse.	SK-181	230	450/1000
4— 75	G.E.	TLC-50	250	850/2500

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—	3000	G.E.	25/60	4000/2300x2300/4000
1—	1000	G.E.	25/58	4400/2300
1—	500	A.C.	25/60	11000/2300Y

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed
1	5000	Whse.	4150	600

TRANSFORMERS

60 Cycles

Qu.	KVA	Make	Type	Ph.	Voltages
2	4000	G.E.	HT	3	22000x2300
3	1500	Pitts.	OISC	1	22000x2300
3	1250	G.E.	H	1	6600x580
1	500	Whse.	OISC	1	24650x432
1	500	Whse.	OISC	3	13400x216
6	300	G.E.	HT	3	13200x240/480
3	300	G.E.	HT	3	4900x240/480
9	300	G.E.	HT	3	2400x240/480
3	150	Pitts.	OISC	1	480x240/120
3	100	G.E.	OISC	1	2400x120/240
3	75	Pitts.	OISC	1	480x120/240

RECTIFIERS

1— 750	G.E.	BHW	575	2300
1—1000	A.C.	B-612	625	13500
1—1000*	A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—2500	G.E.	TS	2300	257
2—2000	Whse.		2300	120
2— 900	Al. Ch.	(New)	2200	150
3— 725	G.E.	ATI	2200/12000	600
1— 650	Whse.	G	2200	138
1— 450	Whse.	Eng.	2200	128.5
2— 350	G.E.	TS	2200	150
1— 300	Whse.		2300	720
1— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600

SLIP RING

1— 500	Whse.	CW	550	350
2— 500	G.E. unused	M-574Y	2200	900
1— 500	G.E.	IP	550	505
1— 500	G.E.	IM-MIII	2200	450
1— 500	G.E.	IM	440	900
1— 350	G.E.	MT442-Y	2200/4000	257
1— 300	Al. Ch.	3 Brg.	2300	505
4— 300	G.E.	ITC-5017	550	585
1— 300	Al. Chal.	ANY	2200	708
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
1— 200	G.E.	MTP	440	1170
3— 200	G.E.	IM-17	440	580
1— 150 new	Whse.	CW	2300	450
4— 125	G.E.	MT-566Y	440/2200	425
4— 100	G.E.	MT-566Y	440/2200	425
1— 100	G.E.	IM-16	2200	435
2— 100	G.E.	IM	440	600
3— 100	Al. Ch.	ANY	440	685
1— 100	G.E.	MT556	2200	900
1— 75	Whse.	CW-761	2200	1725

SQUIRREL CAGE

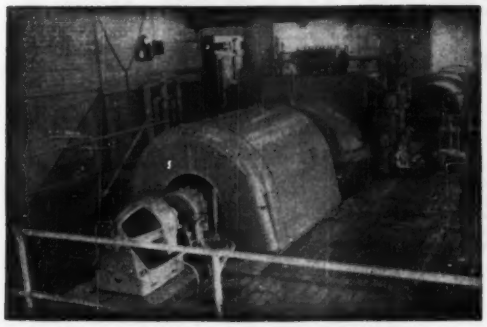
2— 650	G.E.	FT550BY	440	3750
2— 450	Whse.	CS	2300/4150	854
1— 300	G.E.	RT-574Y	2300	505
1— 200	G.E.	IK-17	440	580
1— 200	G.E.	KT557	440	1800
1— 200	G.E.	IK	440	685
1— 150	Weighse.	C8856B	440	880
1— 125	Whse.	MS	440	485
1— 125	G.E.	KF-TEFC	440	3585
2— 125	Al. Ch.	ARW	2300	1750
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-513	220/440	1750
1— 100	G.E.	KT-554	440	900

RE NU BILT BELYEA MOTORS

BELYEA COMPANY, Inc.

43 HOWELL ST., JERSEY CITY, N. J.
PHONE—JOURNAL SQUARE 2-3334
N. Y. LINE—RECTOR 2-7150

• TURBO GENERATORS •

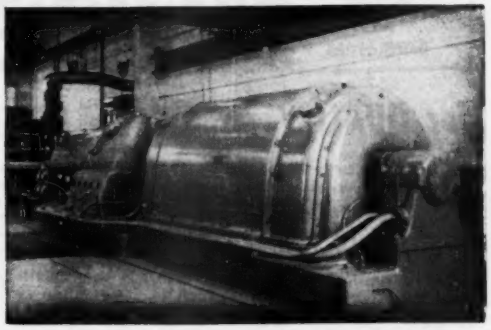


Actual Photo—2500 KW

GENERAL ELECTRIC TURBO UNIT

TURBO: 2500 KW, 3600 r.p.m., Form AA, 11 stage, 800 lbs. ISP, 750° FTT, 200 lbs. G.
AUTOMATIC EXTRACTION, 2½" abs. condensing.
GENERATOR: 2500 KW, 3600 r.p.m., 3125 KVA, 80% p.f., type ATB-2 form T, 3 phase, 60 cycle, 2300 volt.
EXCITER, 25 KW, 125 volt, 3600 r.p.m. direct connected. Complete operating panel.
CONDENSER: Alberger, surface type, 2 pass, complete with circulating, condensate and air removal pumps.
WATER RATES: Calculated at 800 lbs. I.S.P., 750° F.T.T., and 2½" abs.—KW—Lbs. per KW Hr.

3125 KVA	10.89	1875 KW	11.22
2500 KW	10.89	1250 KW	11.92



Actual Photo—6000 KW

ALLIS CHALMERS TURBO UNIT

TURBO: 6000 KW, 3600 r.p.m., 200/225 lbs. I.S.P., 550° F.T.T., 2½" abs., condensing.

GENERATOR: 6000 KW, 3600 r.p.m., 7500 KVA, 80% p.f., 3 phase, 60 cycle, 2300/4100 volts.

EXCITER: 50 KW TURBO UNIT, 125 volt complete operating panel.

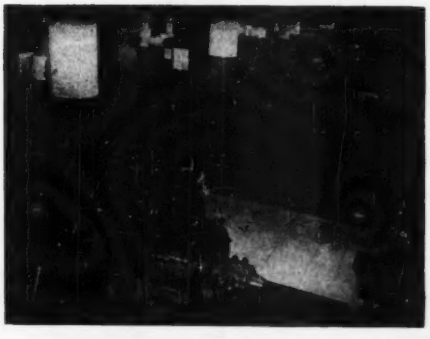
CONDENSER: ALLIS-CHALMERS, Surface type, 2 pass, complete with circulating, condensate and air removal pumps.

This installation may be purchased in its entirety or in parts, and we will be pleased to supply additional information upon inquiry. The 2500 KW G.E. Electric Unit served as a topping installation for the 6000 KW Turbo Unit; and associated equipment included one

• B & W STIRLING BOILER •

100,000 lbs. per. hr., 800 lbs. pressure, 800° F.T.T. complete with pumps, pulverizers, gauges, valves, and standard trim.

Recently Acquired Geared D.C. Turbo Units



2—1000 KW—G.E.—Non-Condensing 200# ISP—100° S.H.—5/20# B.P. 480/3/60.

1—1000 KW—Moore-GE. Condensing Mixed Pressure—200# ISP—100° S.H. 250V. D.C.

2—500 KW—G.E. Non-Condensing 200# ISP—100° S.H. —5/10# B.P.—250V. D.C.

Photo at left shows installation can be inspected as shown.

BELYEA COMPANY, INC.

43 HOWELL STREET JERSEY CITY 6, N. J.

ELECTRIC MOTORS AND GENERATORS

WAGNER CERTIFIED REBUILT WAGNER

BACKED BY 45 YEARS OF QUALITY AND SERVICE

For QUALITY • SERVICE • PRICE - "Check with WAGNER First!"

OVER 45 YEARS OF EXPERIENCE is back of every machine sold by Arthur Wagner Company. Large stocks and modern facilities insure ample choice and prompt service at reasonable cost. All Wagner "Certified Rebuilt" equipment conforms to standards approved by National Industrial Service Association. Inspect our shop and stock—see why it pays to . . . "Check with Wagner First!"

M-G SETS

KW	Mfr	Input V	Output V
500	G.E. HCC conv.	2300 AC	275 DC
300	Allis Ch.	2300/440 AC	125/250 DC
300	G.E.*	2300/440 AC	275 DC
200	Whse.*	2300 AC	275 DC
200	Gen. Elec.*	230/440 AC	125 DC
150	Gen. Elec.*	2300/440 AC	600 DC
150	Whse.*	220/440 AC	125/250 DC
105	Century b.b.	230/440 AC	70 DC
100	Allis Ch.* (2)	2300/440 AC	60 DC
100	Whse.	230 DC	230 DC
100	Whse.*	220/440 AC	230 DC
100	Gen. Elec.	220/440 AC	125 DC
100	Gen. Elec.*	220/440 AC	250 DC
75	Whse. (3)	220/440 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
65	Whse.	220/440 AC	250 DC
60	Gen. Elec.*	220/440 AC	250 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
45	Cr. Wh. b.b.	220/440 AC	125 DC
40	Gen. Elec.	220/440 AC	550 DC
40	Whse. (3)	220/440 AC	125 DC
40	G.E.	220/440 AC	250 DC
35	Cr. Wh. b.b.	220/440 AC	125 DC
25	Gen. Elec.	220/440 AC	250 DC
25	G.E. b.b. New	220/440 AC	125 DC
20	Northw'n.	220/440 AC	250 DC

*Syn. motor drive.

D.C. MOTORS

HP	Mfr	Type	Volts	Speed
200	Gen. Elec.	CD189A	230	600/1200
150	Cr. Wh. TEFC	83H	230	850
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1600
100	Gen. Elec.	CD128	230	850
75	Whse TEI	SK183	230	850
75	Northw'n	K50	230	1750
60	Cr. Wh.	50H	230	725
60	Reliance b.b.	851T	230	750
50	Gen. Elec.	RLC 204	230	500/1500
50	Gen. Elec.	LC	115	600/800
50	Cr. Wheeler	CMC	230	1750
50	Century New	5A1	230	600/1150
40	Gen. Elec.	RC93	230	1500
40	Gen. Elec.	RC-83	230	1150
40	Cr. Wheeler	EH	230	1750
40	Whse.	SK140	230	775
40	Gen. Elec. (2)	CD115	230	575/1150
35/50	Gen. Elec.	CD128	230	575/1150
30	Whse.	SK116L		1150
30	Whse.	SK90	230	1750
30	Star b.b.	SB	230	1750
25	Gen. Elec.	CD85	230	1750
25	Whse.	SK150	230	800/1750
25	G.E. b.b. New	CDM93	115	1150
25	Gen. Elec.	RP13	230	850/1600
25	Whse.	SK	230	1150
20	Whse. b.b. (2)	SK97	550	900
20	Gen. Elec. (2)	CD83	230	1750
20	Gen. Elec.	RP12	230	400/1600

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC.
- FREQUENCY CHANGERS.
- CIRCUIT BREAKERS, AC & DC.
- SPEED REDUCERS.

D. C. GENERATORS

KW	Mfr	Type	Volts	Speed
300	Gen. Elec. 1 brg.	DMC	275	720
150	Whse.	SK191	125/250	900
105	Century b.b.	1500 amp	70	1180
100	Gen. Elec.	CD	250	1200
100	Gen. Elec.	C	250	750
75	Reliance b.b. New	2197	250	1200
75	Whse.	SK	250	1200
75	Gen. Elec.	RC36	125	1200
60	Whse.	SK140	250	1100
60	Gen. Elec.	LC	250	700
50	Allis Ch. (2)	EW	125/250	1200
50	Cr. Wheeler	50H	250	900
40	Cr. Wh. b.b.	FH	125	1750
40	Whse.	SK	250	1200
40	Gen. Elec. (2)	RC32	250	1500
40	Gen. Elec.	RC32	850	1500
25	G.E. b.b. New	CDM93	115	1150
25	Whse.	SK	250	1750
20	Gen. Elec. (2)	RC	125	1150
15	Star b.b. (5)	SQ	250	1750

A. C. GENERATORS — 60 CYCLE

KVA	Mfr	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
500	Allis Ch.	3 brg.	240/480	360
500	Gen. Elec.	ATB	240/480	900
312	Gen. Elec.	ATB	240/480	600
313	Gen. Elec.	ATI	240/480	900
300	Gen. Elec.	ATB	600	720
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	240/480	600
125	Gen. Elec.	ATB	240/480	300
90	Gen. Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
75	Gen. Elec.	ATI	240/480	1200
56	Gen. Elec.	ATB	240/480	1200
56	Gen. Elec.	ATB	240/480	900
81	Whse. b.b.	late	150/208	1200
10	Kato New (30)	b.b.	127/220	1800

A. C. MOTORS — SLIP RING
3 Phase 60 Cycle 220 or 440 Volts

QU	HP	Mfr	Type	Speed
1—	600	Gen. Elec.	IM	360
1—	500	G.E. 3 brg.	I-M	450
1—	400	Gen. Elec.	I-M	514
1—	350	Whse. 2200V.	CW	450
1—	300	G.E. 2300V.	I-M	1800
1—	300	Gen. Elec.	I-M	720

1—	250	G.E. 2300V.	IM-17A	600
1—	250	Allis Ch. 2300V.	ANY	514
1—	250	Cr. Wheeler	SR	600
1—	200	Cr. Wheeler	SR	600
1—	200	Gen. Elec.	I-M	360
2—	200	Gen. Elec.	I-M	600
1—	150	G.E. 2300/4400V. Vert.	I-M	1200
1—	150	Gen. Elec.	I-M-17	450
1—	150	G.E.	IM-10	600
1—	125	Allis Ch.	ANY	900
1—	100	Gen. Elec.	I-M	720
2—	100	Gen. Elec.	I-M	514
1—	100	Gen. Elec.	I-M	1800
1—	100	G.E. Vertical	MT533	1200
1—	100	Cr. Wheeler	SR	600
1—	100	Northwestern	HW	1800
1—	75	Gen. Elec.	MT533	900
1—	75	Whse. 2300V.	CW	600
2—	75	Gen. Elec.	MT343	1800
1—	60	G.E. TEFC b.b.	M-5326	720
1—	60	Fair. Morse	BV	720
1—	60	Whse. 2300V.	CW716C	900
1—	60	Gen. Elec.	MT343	1200
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Gen. Elec. Int.	ITC5613	600
2—	40	Whse.	CW4504A	1200
1—	40	Gen. Elec.	MT533	600
2—	30	Gen. Elec.	MT326	1200
2—	30	G.E. 2300V.	MT333	900
2—	30	Gen. Elec.	MT332	900
2—	25	Gen. Elec.	MT	900
2—	25	Gen. Elec. Int.	MTC5528	720
3—	20	Whse. b.b. New	CW344	1800

A. C. MOTORS — SYNCHRONOUS

HP	Mfr	Type	Volts	Speed
700	Gen. Elec.	TS7659	2200	514
500	Gen. Elec.	ATI	220/440	900
500	Gen. Elec.	ATI	2300/560	450
300	Whse.	G	2300/440	600
300	Gen. Elec.	ATI	220/440	900
275	G.E. 25 cycle		220/440	750
250	Gen. Elec.	TS	220/440	360
225	El. Machy.	BRKT	220/440	1800
200	Allis Ch. (2)	SPF	2200/440	720
220	G.E. 3 brg. .8 PF	ATI	220/440	600
200	G.E.	TS	220/440	150
190	El. Machy.	3 brg.	220/440	514
175	Whse.	2 brg.	220/440	360
150	Gen. Elec.	ATI	220/440	1200
125	El. Machy. (2)		220/440	1800
120	Burke b.b. .8PF	AC19	2200/440	1200
125	El. Machy.	B.R.	2400/4800	900
100	American b.b.	YOH	220/440	900
90	Gen. Elec.	TS7545	220/440	1200

A. C. MOTORS — SQUIRREL CAGE
3 Phase 60 Cycle 220 or 440 Volts

QU	HP	Mfr	Type	Speed
1—	500	G.E. 6600/4000 V.	I-K	1800
1—	500	Fair. Morse 2200V.	H8	1200
1—	300	G.E. 2200V.	KTF581	1800
1—	300	Gen. Elec.	I-K	600
2—	250	Whse. 2300V.	C8	1200
1—	250	Gen. Elec.	FT549AZ	3600
1—	250	Gen. Elec.	IK-17A	450
1—	250	Gen. Elec.	IK-17	600
1—	250	Gen. Elec.	I-K	720
1—	200	Gen. Elec.	IK-17	514
2—	200	Reliance b.b. New	B60858	1800
2—	200	Gen. Elec.	I-K	600
1—	200	G.E. 3 brg.	I-K	400
1—	200	Gen. Elec.	KT546	600
1—	200	U. S. b.b. New	SC587	1200
2—	200	Gen. Elec.	I-K-E13B	1800
2—	150	U. S. b.b. New	SC587	1200
1—	150	Reliance b.b. New	C6085	900
1—	150	Gen. Elec.	KT549	1800
2—	150	Gen. Elec. 2200V.	IK-15A	720
1—	150	Gen. Elec.	IK-16	600
1—	150	Gen. Elec. TEFC b.b.	K63338	1200
1—	150	Gen. Elec.	IK-17	450
1—	150	Whse	C8	720
8—	125	Al. Ch. 2200V. b.b.	ARX-826	900
1—	125	Rel. TEFC New	B60858	1800
2—	125	Gen. Elec.	K-558	900
1—	125	G.E. b.b. New	K63248	1200
1—	125	G.E. New b.b. HT	KG6324	1200
1—	125	Con. 2200V. b.b.	SC	1800
2—	125	G.E. 2200V. TEFC	K6328	3600
2—	125	Reliance b.b. New	5058	1800
1—	125	Reliance b.b. New	B6085	900
2—	100	Reliance b.b. New	50848	1800
1—	100	Reliance TEFC New	B5085	1200
1—	100	Whse.	C8	720
1—	100	Gen. Elec.	I-K	1200
1—	100	Rel. TEFC New	5058	3600
1—	75	Rel. TEFC New	5048	3600
1—	75/90	Gen. Elec.	IK	3600
2—	75	Whse.	C8	720
1—	75	Fair. Morse b.b.	HJQ	600
1—	75	Reliance b.b. NEW	C8084	900
2—	75	Reliance b.b. NEW	C505	1800
1—	75	G.E. TEFC 2200V.	K-6325	900
1—	75	Gen. Elec.	I-K-14	600
1—	75	G.E. Expl. Pf. 2200V.	K6325	1200
2—	60	Gen. Elec.	KT548	900
2—	60	Howell b.b.	K504	1200
2—	60	Gen. Elec.	KT536	450
2—	60	Reliance b.b. New	CC505	900
2—	60	G.E. Vertical	KT536	1200
1—	60	Gen. Elec.	I-K	600
2—	60	G.E. 2200V.	KT533	1800
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Reliance TEFC NEW	C505	1200
1—	50	Gen. Elec.	KT546	720
2—	50	G.E. Vertical	KT548	720
2—	50	Reliance b.b. New	CC504U	900
2—	50	Whse.	C8	1200
2—	50	Howell TEFC	K445	1800
1—	50	Whse. hislip	WL407	900
1—	50	Fair. Morse b.b.	HJ-13D	900
1—	50	Gen. Elec.	KT537	1800
2—	40	Reliance b.b. New	CB404	1800
1—	40	Louis Allis b.b.	OX404	3600
2—	40	Gen. Elec.	KT532	1200
2—	40	Gen. Elec.	KT538	900
2—	40	Gen. Elec.	KT546	600
7—	40	Whse. b.b.	CS-504	1200/900

A. C. MOTORS — 25 CYCLE

HP	Mfr	Type	Volts	Speed
275	G.E. synch.	ATI	440	750
150	Whse.	HP	440	500
60	Allis Ch.	ARY	440	1500
50	Gen. Elec. Int.	MTC5337	440	750
50	Gen. Elec.	I-K	440	750
30	Gen. Elec.	MT343	440	750

Arthur Wagner Co.
1435 W. RANDOLPH ST. MOnroe 6-7400 CHICAGO 7, ILLINOIS

QUICK SHIPMENT FROM STOCK—
LOW PRICES — FULL GUARANTEE
Send for Complete Stock Lists

BUY or RENT From L. J. LAND for

- Dependable Equipment
- Reliable Rebuilding
- 1 YEAR GUARANTEE
- REAL VALUES

1 to 50 HP
NEW and REBUILT
TEFC—EX. PR.—Drip proof and Splash proof—Geared Head
IN STOCK

SQUIRREL CAGE MOTORS
3 phase

H.P.	Make	Type	Speed
250	G.E.	KT 559	1750
200	Wagner	RP226F	1800
200	Al.Ch. (2)	BB	880
200	G.E.	KF-6335	880
150	West.	CS	1150
150	West.	CS	580
125	Al. Ch.	AR	1750
100	West.	TEFC	3600
100	Al. Ch.	AR	1150
100	West.	CS	870
100	G.E.	IE-K	1800
100	G.E.	K-544	1175
75	West. (2)	CS-654C	1750
75	G.E.	IK	900
75	G.E.	KT-352	865
75	West.	CS	720
60	Howell	SCR	1800
60	West. (2)	CS-607	880
60	Rel.	AA	875
60	G.E.	KT-346	865
60	G.E.	TEFC(GH)	427
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	G.E. (2)	KT	1740
50	G.E.	XP	1750
50	G.E.	KF-445	1170
50	West (3)	CS	870
50	G.E. (2)	IK	870

SLIPRING MOTORS
3 Phase

H.P.	Make	Type	Speed
600	Cr. Wh.	131AQ	507
500	G.E. (2)	IM	450
500	Ideal		1150
400	West.	CW	450
400	G.E.	IM	870
250	G.E.	IM	435
225	Wagner	25 cy.	710
200	G.E.	MT559Y	1170
150	Wagner	31VRN	900
150	Burke		720
125	West.	CW	1750
125	Burke		600
100	G.E.	MT347	1150
100	G.E.	IM	690
75	Lincoln	IXM	1750
75	West.	CW	1150
75	West.	CW	720
75	G.E.	IM	690
60	G.E.	MT533	1750
60	West.	CW116	290
50	G.E.	MT-536	1150
50	Wagner		1150
50	L.A.	OGH	870
50	Cr. Wh.		900
50	G.E.	MT546	720
50	G.E.	IM	490

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
475	West.		720
300	G.E.	ATI	900
260	G.E.	TS	900
200	West. (3)		900
180	G.E.	ATI	900
150	G.E.	TS	900
150	G.E.	TS	720
150	G.E.	ATI	900
100	G.E.	ATI	1200
75	G.E. (2)	TS	900
55	El.Machry.	BRKT	1200

230 V.D.C. MOTORS

H.P.	Make	Type	Speed
200	West.	SK210	575
150	G.E.	L.C.	1750
100	Al.Ch.		1150
90/45	G.E.	RF-17	950/475
75	G.E.	RC36	800
75	West (2)	SK-180	475
75	Cr. Wh.	CMC	375/950
60	West.	SK-160	680
60	West.	SK	250/1000
50	G.E.	CD	3600
45/90	G.E.	RF-17	475/1950
50	West. (3)	SK-160	565
50	G.E.	CD	3600
50	G.E.	RF-17	250/1000
40	West.	SK-103	1750
40	G.E.	RC-31	1700
40	G.E.	CD-1441	400/1500
40	Rel.	461T	400/1200
35	West.	SK	250/1000
35	West.	SK-120	1150
35	G.E.	RLC	440/800
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West.	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	Rel.	92T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	600
25	G.E.	RF-14	800/1200
25	West.	SK113	850

115 V.D.C. MOTORS

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CCM	900
40	G.E.	DLC	1150
40	G.E.	RC	1050
40	G.E.	CD-113	850
30	Eck.		950
25	G.E. (2)	CD	1800
25	G.E.	CD93	1150
25	Cr.Wh.	CCM	780
25	West.	SA	600/1200
20	G.E.	CD85	1150
15	E.D.	7½S	650/1230
15	Cr.Wh.	CM	650
15	Cr.Wh.		1800
15	G.E.	RC	1200
10	Al.Ch.		900
10	E.D.	7½S	425/1700

550 V.D.C. MOTORS

HP	Make	Type	Speed
765	G.E. (3)	MPC	1045/1350

AC GENERATORS

KW	Make	Speed
180	G.E. ATB	900
100	G.E. ATB	360
40	G.E. ASI	1200
15	G.E. ASI	1200

AC GENERATORS
Driven by DC Motors

KVA	Make	D.C. Input	A.C. Output
62½	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	Ely. Machry.	230	440
18	G.E. (3)	230	120/240
10	Burke	115	120
7½	Hertner	115	440
6¼	G.E.	230	240
5	El. Spec.	115	110
1¼	Al. Ch.	230	110

600 V.D.C. GENERATORS

KW	Make	Speed
400	G.E. (4)	1200
325	G.E.	1200
30	Burke	1750
20	Reliance	1150

GENERATORS
250 V.D.C. Motor Driven

KW	Make	Speed
300	Elliott	1200
250	G.E.	1150
200	G.E.	1200
150	West.	900
100	Delco	1200
100	G.E.	700
75	G.E.	1200
40	Rel.	1750
42	ABC (2)	1200
30	G.E.	1200
25	G.E.	1200

125 V.D.C. Motor Driven

KW	Make	Speed
150	West. (2)	1200
100	West. (2)	900
100	G.E.	1200
100	El. Machry.	1200
100	West.	1200
50	West. (2)	1150
30	G.E.	1150
30	L.A.	1450
25	El. Machry.	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
10,000	HVW	2½/10
10,000	North.	2½/10
7,500	HVW	2½/10
2,500	Chandeysson	6/12
125	Hobart	7½
500	Chandeysson	12
1,000	West. SK	24
1,500	Century	24
2,000	G.E.	24V
150	G.E.	30
1,000	G.E.	33
150	Watton	40
1,000	Chandeysson	40
200	G.E.	42
1,500	G.E.	50
1,500	Century	60
1,500	G.E.	60
1,000	G.E.	75

FREQUENCY CHANGERS AND GENERATORS

Size	Make	Output Frequency
150 KW	G.E.	150 cy.
154 KVA	G.E.	150 cy.
15 KW	G.E.	408 cy.
10 KW	G.E.	200/700 cy.
7½ KW	G.E.	408 cy.
5 KVA	West.	400 cy.

ELECTRIC HOISTS

1000# Y & T—D.C.
1000# Thor—Air.
1000# Y & T—A.C.
1000# Shepard—A.C.
2000# R & M—D.C. (3)
2000# C & M—D.C.
6000# R & M—A.C.

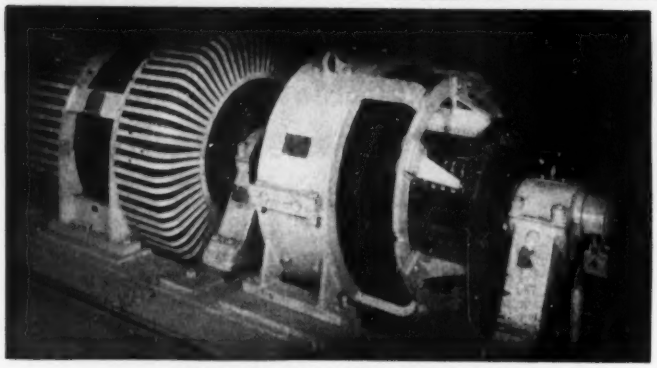
GUARANTEE YOUR INVESTMENTS!

- LAND gives 1 year guarantee.
- All equipment listed in stock.
- You can see your machines run and tested under power before shipment.
- Complete shop facilities with thoroughly trained & experienced mechanics (many have been with us over 25 years).
- Responsible Organization —41 years' experience.

Partial List ONLY

EST. 1910 — L. J. LAND INC. — 41st YEAR

156 GRAND STREET — NEW YORK 13, N. Y.



500 K.W. Westinghouse Motor Generator Set

MOTOR GENERATOR SETS
Philadelphia Stock

1—1000 K.W. Westinghouse 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Motor .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels Modern Unit—Can furnish 60 cycle 2300 or 13200 volt.

1—600 KW G.E. MPC—2400 amp. 230 volt 514 RPM with 1050 H.P. G.E.—ATI Syn. Motor .8 P.F. 2 phase, 60 cycle, 2300 volt A.C. & D.C. Panels—Can furnish 3 ph. 550 V. or 2300 V.

1—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/6600/13200 volt, Serial #8130447-48 (year 1935) See actual photo above.

1—500 K.W. Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/6/2300 V. A.C. & D.C. Panels.

1—300 K.W. West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.

1—300 K.W. Elliott 250 Volt 1200 RPM with 500 H.P. Syn. Motor 3/60/2300/1200 RPM—Automatic Controller & D.C. Panel.

1—150 K.W. G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels.

1—100 K.W. Al. Chalmers 250 Volt 1200 RPM 150 H.P. Syn. Motor 2/60 or 3/60 any voltage.

1—100 K.W. G.E.—C.D.—125 Volt D.C. 150 H.P. GE Syn. Motor, 3/60/220/440/1200 RPM.

1—75 K.W. Burke 250 Volt, 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 phase, any voltage.

Smaller Sizes and Types—Advise Requirements.

DIESEL GENERATORS

2—1250 KVA GM 3/60/2300/720 RPM complete Plants—Used 4 years.

1—1000 KVA Hamilton 99 DA 3/60/2300/4160 600 RPM—New 1943—Never used.

1—625 KVA Baldwin—Series 600 3/60/2300/514 RPM—New 1948—1500 hours.

1—225 KVA General Motors, Twin 671, 3/60/440. —New 1941.

ELECTRIC MOTORS

Q.	H.P.	Make	Type	Volts	Speed
1	1200	Cr. Wh.	Sl. Rg.	2300	257
2	600	West.	Syn.	440	257
3	500	West.	CS	6600	514
1	400	G.E.	Syn.	2300	450
1	400	West.	CW	440/2300	600
1	400	West.	CW	440	514
1	350	G.E.	MT18	2300	400
1	315	G.E.	Syn.	2200	720
1	200	West.	Syn.	2300	1200
1	200	West.	MW	440	600
1	150	Ideal	Syn.	220	1200
1	125	West.	Syn. (3 brg.)	550	600
1	125	Cent.	SC	440	1800
2	100	G.E.	Syn.	440	300
1	75	West.	CW	440	1200
1	60	West.	CW	440	720
1	50	West.	CS	440	3600
2	50	Cent. (new)	SC	220	1200
1	40	G.E.	MT536	440	900
1	30	G.E.	MT532	440	900
2	25	G.E.	MT332	440	900

DOWTHERM VAPORIZER

1—1,000,000 BTU, No. 33-3A McKee gas fired Dowtherm Vaporizer, receiving tank, condensers, coolers, etc. Year 1940.

AIR COMPRESSORS

1—12,000 CFM Ingersoll-Rand Turbo Compressor, 3.25# pressure, 250 HP, 3/60/440/3600 RPM.

1—880 CFM Worthington Syn. motor drive 150 H.P. 3/60/440/277 RPM, size 17x10½x12.

1—734 CFM Sullivan 60 lb., 13 and 13x8.

2—528 CFM Chicago NSB, 100 lb., 285 RPM V-belt 14x12.

2—368 CFM Ingersoll ER-1, 285 RPM, 100 psi., 50 HP, M.D. 3/60/220.

1—340 CFM Schramm Vertical V belted on steel base, 75 HP motor 3/60/220.

1—277 CFM Chicago PB4 Air Cooled 50 HP V-Belt Motor Drive.

1—215 CFM Penna. 3A 10x8, 50 lb.

2—175 CFM Ingersoll ER-1, 9x8, 300 RPM, 100 LB., V-belt.

2—89 CFM Chi. TB—6x7—150 lb.

CENTRIFUGAL PUMPS

Q	GPM	THH	Description	Size	HP	Speed
2	10,000	200'	LeCourtenay	20"	624	870
2	10,000	100'	LeCourtenay	20"	350	870
1	10,000	114'	De Laval	18"	370	988
1	9,000	88'	De Laval	18"	250	870
2	8,150	132'	LeCourtenay	16"	350	1150
1	8,000	110'	Worthington	14"	500	1200
2	7,000	200'	LeCourtenay	16"	423	1000
2	6,500	100'	Worthington	14"	200	1200
1	6,000	110'	Ingersoll-Rand	12"	500	1200
2	5,000	125'	Worthington	14"	200	1200
1	4,000	110'	Ingersoll-Rand	12"	500	1200
1	3,500	47'	Southwalk	12"	75	870
1	3,100	42'	Worthington	12"	50	1150
2	2,550	200'	De Laval	8"	200	1750
1	2,310	24'	Worthington	12"	20	860
2	1,700	95'	De Laval	10"	60	1750
1	1,500	231'	Allis-Chalmers	8"	150	1750
3	1,200	40'	Worthington	6"	15	1750

TURBO GENERATORS

1—625 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Condensing 180 PSI 35 lb. B.P. New 1936.

1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.

1—300 KW West. 3 wire 125/250 Volt D.C., Non-Cond. Turbo Units 125 PSI, 5 lb. B.P. New 1938—(See Actual Photo.)

1—75 KW G.E. Non-Cond. D.C. 125 volt.

1—35 KW G.E. Non-Cond. D.C. 125 volt.

BOILERS (ASME)

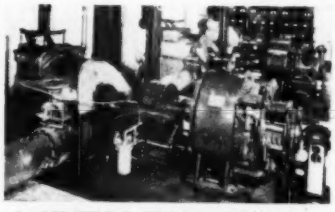
1—106 H.P., Keeler, Self-contained, 125#

2—240 H.P., Keeler, Horizontal, Long-Drum, Water Tube, 200#

1—250 H.P., Bigelow, Self-contained, 125#

2—360 H.P., Springfield, Cr. Drum, Str. Tube, Sect. Hdr., Water wall, 250#

1—390 H.P., Springfield, Cr. Drum, Str. Tube, Sect. Hdr. Water wall, 300#



3—300 KW D.C. TURBOS—125/250 Volt

"Everything from a Pulley to a Powerhouse"

1915

THE O'BRIEN MACHINERY CO.

T.M. REGISTERED U.S. PATENT OFFICE

PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

Cable Address: OBRIEN PHILA.

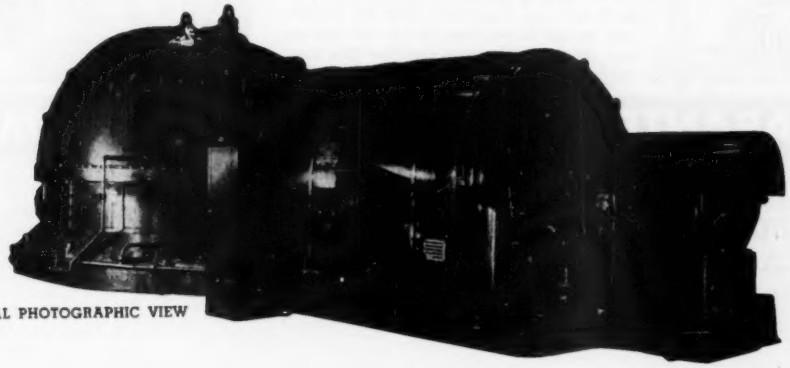
1547 North Delaware Avenue • Philadelphia 25, Pa., USA — Bell Phone Garfield 6-1150

AFFILIATED WITH

SOC EXPANSÃO INDUSTRIAL SUL AMERICANA LTDA

RIO DE JANEIRO — BRASIL

25,000 KVA—20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° T.T. complete with direct connected shaft exciter, switchboard, a 30,000 square foot Westinghouse surface condenser and condensing accessories, including 2—150,000 pounds steam per hour B&W sectional header cross drum boilers, 250# pres., 550° T.T. equipped with Taylor retort stokers.



ACTUAL PHOTOGRAPHIC VIEW

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

Condensing—3 phase, 60 cycle

6250 KVA G.E., 5-stage, 2300/4000 volts, 200# P.S.I., 600° TT.

4000 KVA Allis, 2300 volts, 150-200 PSI.

3750 KVA Westghse. 2300 volt, 200 PSI.

2500 KVA G.E. Type AT8, Form HT, 2300/480 volts, 3600 RPM, 2-bearing alternating current generator LESS TURBINE.

2500 KVA Westghse. 2300 volt, 250 PSI.

1875 KVA Westghse. 2300 volts, 250 PSI.

1563 KVA Allis, 600 volts, 200 PSI.

1250 KVA G.E. AUTOMATIC EXTRACTION BLEEDER 2300 volts, 250 PSI.

937 KVA Allis, 480 volts, 250 PSI.

780 KVA Allis, 480 volts, 150 PSI.

625 KVA G.E. 480 volts, 150 PSI.

Non-condensing—3 phase, 60 cycle

940 KVA Allis 2300/480 volts, 125-150 PSI 12# back.

625 KVA G.E. 480 volts, 125-150 PSI, 20# back.

375 KVA Westghse-Moore 480 volts, 250 PSI 5-10# back.

125 KVA G.E., 2300 volts, 150-200 PSI.

125 KVA Westghse. 2400 volts, 150-250 PSI 10# back.

Direct Current

500 KW G.E., 250 volt, 200 P.S.I., 25# gauge back non-condensing.

300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing.

100 KW (2) G.E., 125 volts, 200-275 PSI.

75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.

60 KW (2) Elliott, 125 volt, 200-250 P.S.I. non-condensing.

MOTOR GENERATOR SETS

100 KVA Westghse. 60 cycle, 2400 volts, alternator connected 135 HP, 250 volt direct current motor.

62½ KVA G.E., 60 cycle, 2300 volt alternator to 75 HP, 125 volt DC motor.

50 KW G.E. 125 volt direct current 1200 RPM to a 3 phase, 60 cycle, 220 volt syn. motor.

10 KW G.E. 125 volts direct current to 12 HP 60 cycle, 220 volt motor.

DECEMBER BARGAINS
SPECIALLY PRICED

547 HP, 250# pres. and two 400 HP, 200# pres. B&W water tube boilers with stokers.

8000 sq. ft. Wheeler, 4400 sq ft. Worthington, 2000 sq. ft. Worthington and one 1500 sq. ft. Westinghouse surface condensers.

4900 GPM and 3500 GPM Allis 2-stage pumps, 130 ft. hd. each direct connected 400-325 HP Allis 3 phase, 60 cycle, 2300 volt motor.

1250 KVA E.M. 3 phase, 60 cycle, 4000/2300 volts synchronous generator direct connected 38D8-1/8 O.P. Fairbanks Diesel Engine.

2—1000 GPM, 1270 foot head, 4-stage Morris pumps each connected 417 HP, 390# P.S.I., G.E. turbine.

SYNCHRONOUS MOTORS

3 phase, 60 cycle

5000 KVA Westinghouse, 4000 volt, 720 RPM Electrical Syn. (condenser).

900 HP Allis, 2200 volts, 150 RPM.

UNAFLOW GENERATOR UNITS

Alternating Current—3 phase, 60 cycle

500 KVA G.E., 2400/480/240 volts generator connected Ames Vertical Engine, 150 PSI—5# back.

375 KVA G.E., 2300/440 volts generator connected 23"x24" Skinner Horizontal engine, 125-150 PSI.

175 KVA Westghse., 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

Direct Current

400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.

250 KW Crocker Wheeler 125 volt generator direct connected Ames Vertical non-condensing engine 150#.

20 KW Allis 125 volt generator connected Hill vertical Diesel engine.

UMC UTILITIES MACHINERY CORP.
1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

here's the reason...

...YOU CAN FIND EQUIPMENT YOU NEED—

LARGE STOCKS - ON - HAND

Our modern plant houses one of the nation's largest stocks of motors and equipment. Here you will find row upon row of motors, rebuilt and ready for use to meet your requirements. From this complete stock you can be sure that you will find what you need and that it is quality equipment fully guaranteed.

GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A PARTIAL LISTING OF OUR HALF-MILLION DOLLAR STOCK

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
1000	*G.E. (New)	K6347S	1800
750	*G.E.	KT	720
550	*G.E.	KP-559	3600
500	*G.E.	PBG	1800
500	*Fr-Morse	HS	1200
450	*G.E.	KP-567S	1200
400	*Cont. (New)	NZ	1800
400	*A.C.	ARWW	900
400	*G.E.	IK	514
350	*Cr.-Wh.	SC	3600
300	*West.	CS	3600
300	G.E.	IE-K	1200
300	A.C.	AR	900
300	West.	CS	514
250	West. (New)	CS	1800
250	*L.-Allis	DGX-148S	720
250	West.	CS	600
200	*G.E.	IK-13B	1800
200	*G.E.	IK	514
150	G.E.	KT-546	1800
150	G.E.	IE	1800
150	G.E.	KTP	1200
150	West.	CS950A	600
125	West. (New)	CS504	3600
125	*A.C.	AR-226	1800
125	G.E.	K6326S (TEFC)	1200
125	A.C. (New)	AW	1200
125	G.E. (New)	K6333	900
100	A.C. (New)	ARWWT	3600
100	*G.E.	FT542Z	1800
100	G.E.	FTRP	1800
100	*West.	CS	1800
100	A.C. (New)	AW	1200
100	Rel. (New)	AAC (TEFC)	1200
100	U.S. (Vert.)	GFU	1200
100	G.E.	KT558S	720
75	West. (New)	CS505S	1800
75	Triumph	TR16	514
75	G.E.	IK	600

Hundreds of Smaller Motors

HI-PRESSURE PUMPS

GPM	Make	Type	Head
800	Worth.	6DS	925 Ft.
500	Manistee	H	250 Ft.
300	Al.-Ch.	NMZ	800 Ft.

AIR COMPRESSORS

Size	Make	Type	Displ.	Press
9 x 9	Worth.	HB	211	100
9 x 8	Ing. R.	ER1	145	100
8½ x 9	Worth.	HB	170	100
7 x 7	Worth.	HB	122	100

ROTARY CONVERTER

1000 KW Westinghouse, 900 RPM, 600 V DC, 4708/4280 V AC, 6 Ph. 60 cy. with complete starting equipment.

SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
1200	*Cr-Wh.		240
800	*A.C.	3 Brg.	450
650	West.	HE	350
500	*G.E.	IM17B	900
500	West.	CW	350
400	A.C.	3 Brg.	450
400	G.E.	MT-412	450
300	*G.E.	IM-15	1800
300	*G.E.	MT-410	450
250	*G.E.	MT-422	300
200	G.E.	IM	1800
200	*G.E.	IM-16	600
150	*G.E.	IM-16	600
125	*G.E.	MT-549	1800
125	G.E. (New)	M6333	900
125	G.E. (New)	M6334	720
100	A.C.	ANY	900
100	West.	CW	600
100	G.E.	IM	450
75	*A.C.		900
75	Star	OS00	900
75	G.E.	IM-14	600
60	G.E. (New)	M505	1200
60	West.	CW	900
50	G.E.	IM11A	1800
50	A.C.	ARY	1800
50	West.	CW	1200
50	G.E.	MT346	720
50	G.E.	IM	600
50	G.E.	IM14	425
40	G.E.	MT336	1200
40	West.	CW644	900
40	G.E. (New)	M504U	900
35	Fr-Morse (Vert.)	UAB	1800
35	G.E.	IM	1200
30	West.	CW445	900
25	A.C.	ARY220	900
20	G.E.	IM	720
15	L. Allis (New)	OH326	1800

D. C. MOTORS

230 Volts

H.P.	Make	Type	Speed
1000	Westgh. (600 V)		400/800
400	Westgh.		600/1200
375	Westgh.	Ped	650
200	Westgh.	SK210	800
175	Reliance	1400T	675
175	G.E.	ELC11	750
125	G.E.	Marine	1200
100	G.E.	RC34	2500
100	Westgh.	SK173	850
100	A.C.	E152	575
40	Cr.-Wh.	CMC	1750
40	G.E.	CQ2004	600
35	Cr.-Wh.	CM351	700
35	G.E.	C	600
30	Westgh.	SK120	975
30	Cr.-Wh.	CCM	450
30	Westgh.	SK933	1750
30	G.E.	RC31B	1150
25	Westgh.	SK113	850
25	Westgh.	SK100L	1100

MANY OTHERS—1 HP and Up! ALSO 115 VOLT

AC SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

*H.P.	Make	Type	P.F.	Spd.
1420	*Westgh.	Syn.	.7	900
800	G.E.	TS984	1.0	1800
750	*Westgh.		.8	900
700	G.E.	TS		514
320	*Al.-Ch.	Dr. Pf.	1.0	720
300	Cr.-Wh.	Eng.	1.0	300
300	G.E.	ATI-8	.8	900
250	*Al.-Ch.	Dr. Pf.	1.0	720
220	G.E.	ATI	1.0	600
190	El. Machy.	Ped.	1.0	450
150	El. Machy.	EM	.8	720
150	*Westgh.		1.0	300
125	Parkinson			900
125	El. Mach.	Syn.	1.0	900
125	Cr.-Wh.	103-S	1.0	900
125	*G.E.	TS	1.0	277
115	E.-M.	EM	1.0	240
100	Cr.-Wh.	103S	.8	900
100	G.E.	ATB	.8	900
100	Ideal	SMS	1.0	900
75	G.E.	ATI	1.0	900
60	G.E.	TS7536	1.0	1200
40	G.E.	ATB	.8	1200
20	Fynn W.	15VRN		1200
15	Century	ARC365	1.0	1200
4	G.E.	AK (25 cy.)		1500

D. C. MOTORS

ADJUSTABLE SPEED

230 Volts (*115 Volt)

H.	Make	Type	Speed
30	G.E.	C	300/900
30	West.	SA-8	500/1500
20	West.	SK-110L	500/1500
20	A.C.	ER-145	300/1200
15	*Triumph	Planer	225/900
12.5/15	G.E.	RC-116	500/1500
10/15	Reliance	185T	400/1600
10	*Elec-D	7½S	300/1200
10	G.E.	RF-11A	300/1200
10	G.E.	RD-10A	600/1800
10	West.	SK-100	400/1600
10	G.E.	CR-10	450/1350

AC SYNCHRONOUS GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

K.V.A.	Make	Type	P.F.	Spd.
1500	G.E.	ATI	.8	900
1000	*West.	203D	.8	900
250	*Al. Ch. (new)		.8	720
150	El. Mach.	EM	.8	720
112.5	*G.E.	ATB	.8	1200
110	Cr. Wh.	103	.8	900
100	*G.E.	ATB	.8	900
60	Fr.-Morse	B	.8	900
55	G.E.	ATB	.8	1200
50	G.E.	ATB	.8	1200

DIESEL-GENERATORS (2)

NEW—31.25 KVA Rogers AC Generators, 3/60/120/208, d/c Exciter Driven by direct-connected Cummins Diesel Engine, Model H-1 Complete Control Panel—NEW.

1000 KW M.G. SET

3-UNIT

2—500 KW West. DC Gens., 275/137.5 V, 3 wire, 1820 Amps.

D/C TO

1420 HP West. Syn. Motor, 900 RPM 11,000 V. 60 Cy., 3 ph. 3 Brg. on Castiron Factory Base.

M. G. SETS

K.W.	Make	A.C.	D.C.
1000	G.E. (3 U)	11,000	137/275
500	Westgh.	2300	250
500	Westgh.	550	250
500	Cr.-Wh.	220-440	250
450	G.E. (3 Unit)	2300	125/250
400	Westg.	2300	600
250	Westg.-G.E.	440	250
200	Cr.-Wh.	440	250
200	Ridgeway	2200	250
150	G.E.	2300/440	250
150	G.E.	440	250/275
150	Cr.-Wh.	440	250
150	Al.-Ch.	220	125
100	G.E.	440	250
100	G.E.	220	250
100	G.E. Delco	440	120/240
75	Al.-Ch.	440	250
75	Westg.	2300	110
60	Al.-Ch.	2300	110
40	Cr.-Wh.	220	125
40	Elec. P. G.E.	440	250
40	Al.-Ch.	440	250
30	Cr.-Wh.	220	125
25	G.E.	440	250
20	G.E.	440	250
10	G.E.	440	125
10	Cr.-Wh.	220	125
10	G.E.	440	250

D. C. to A. C.

100	G.E.	230	250

TRANSFORMERS

3—2000 KVA Pittsburgh, 1 Phase 12,000 V to 2300 V.
1—750 KVA Westinghouse, AIR—3 Phase, 13800 V to 480 V.
1—750 KVA Westinghouse—AIR—3 Phase, 13,800 V to 2300/4160 V.
3—667 KVA Niagara, 1 Phase 13,000 V. to 480 V.
3—300 KVA General Electric, 3 Ph. 13800 V. to 240/480 V.
3—300 KVA General Electric, 3 Ph. 2400 V. to 240/480 V.
3—50 KVA Allis-Chalmers (new), 1 phase 2400/416-Y V. to 120/240 V.

First Source for 41 Years for Quality Electrical Equipment

CHICAGO Electric Co.

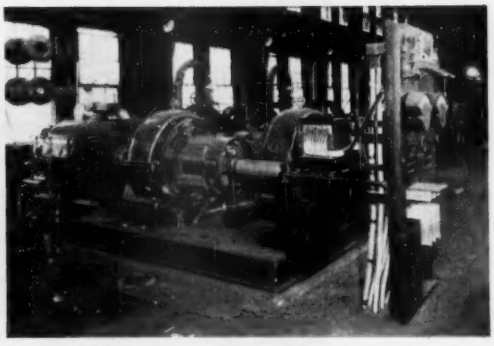
1320 W. CERMAK RD. • CHICAGO 8, ILLINOIS

SPOT DELIVERY • COMPLETE POWER PLANT

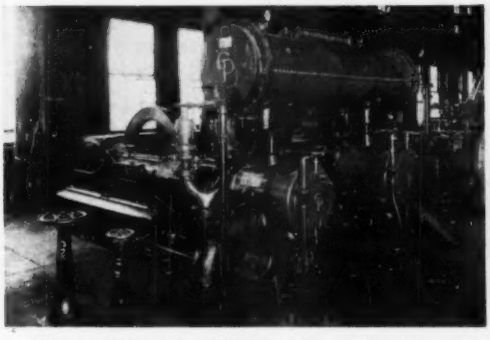
• INSPECTION INVITED •

Boston South Station Terminal – By Appointment

2 alike Westinghouse 500 KW 125/250 V, 900 RPM DC Turbo Sets. Turbines 3600 RPM #12371—Gen. 4571670.



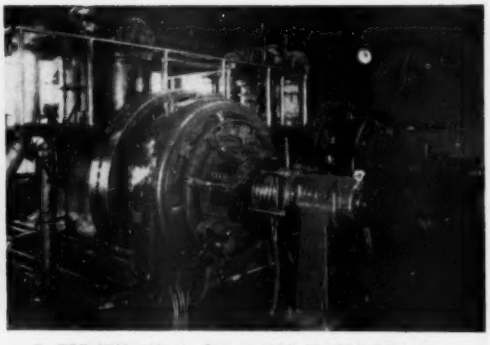
2—125 KW, 125 V, 750 RPM De Laval-Westinghouse Turbine Gen. Sets.



Chicago Pneumatic #13929, Steam Compressor 14x22x20, 12x14, O.C.S.

11—HRT, Boilers 72"x18', 124, Tubes 3". *Insurance approved.*

20 Ton Whiting Crane.



2—225 KW, Westinghouse, 250 V, 250 RPM Compound Eng. Gen. Sets.

2—Economizers
1—520 Pipes
1—240 Pipes
Pumps — Panels — Bus Bar — Draft Fans

FOR PRICES AND INSPECTION — CALL

ELECTRIC EQUIPMENT CO.
"World's Largest Inventory"
Motors — Trans. Gen.
LD65, ROCHESTER, N. Y.
SEE OUR AD PAGE 318

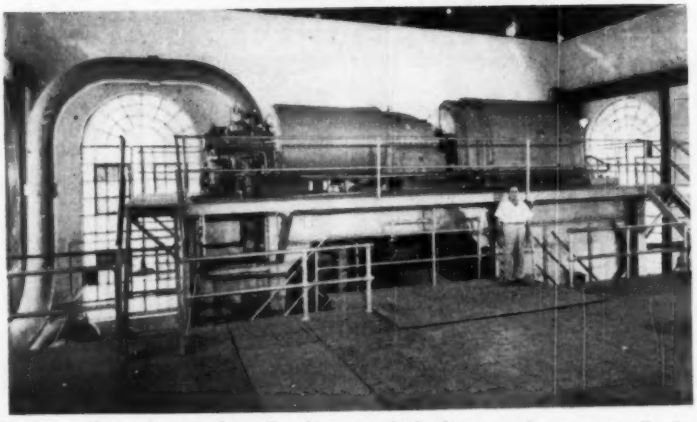
PAUL JAY
NIGHTINGALE 8-0740
50 EXETER ST.
BROOKLYN, N. Y.

AVAILABLE NOW!!!

6250 KVA TURBO-GENERATOR

Condensing

Allis-Chalmers 3600 RPM Now 200 lbs 100° SH Can use without change at 275 lbs 200° SH



3/60/11500 GENERATOR We can make voltage change to suit customer

Inspected by factory service engineer in September this year—absolutely no repairs necessary. Condenser recently retubed—complete auxiliaries. Shut down only because power requirements increased to point where purchased power more advantageous. CAN BE SEEN IN OPERATION.

ALSO IN OUR STOCK

1250 KVA 3600 rpm 3/60/2400 Westinghouse condensing turbo-generator. Completely overhauled by us—new generator winding—top condition. 175 lbs. Complete auxiliaries. Immediate shipment.

1565 KVA 3600 rpm 3/60/2300 Allis-Chalmers condensing turbo-generator. 140 lbs. design—suitable for 200 lbs. 450° TT without change. Good condition.

937 KVA 3600 rpm 3/60/2300 General Electric condensing turbo-generator. 150 lbs. design—new condenser available—good condition.

SUBSTATION EQUIPMENT—Galvanized Steel Substation Structure—rectangular bay 28' x 30' outside x 25' high. Was used for 2 incoming and 2 outgoing 33 KV lines. New 1937—shows no deterioration. Detailed drawings available.

OUTDOOR SWITCH HOUSES: 3—500 amp. 7500 v. Gen. Elec. OCB 125 v. D.C. solenoid operator, 220 v. A.C. rectox, reclosing relay, overcurrent relays, ammeter, auxiliary relays, complete. 1—Type G-1 Westinghouse 2300 v. Type F22 400 amp. OCB, 110 v. A.C. motor operator, reclosing relay, overcurrent relays, ammeter, auxiliary relays, complete. 1—Type B-1 Westinghouse 11500 v. Type B2 600 amp OCB, 125 v. D.C. solenoid operator, CT's and PT's. OCB in these switch houses can be changed and modifications made to your specifications.

OUTDOOR HORN GAP SWITCHES: 12—33 KV HiVoltage Equipment Co. also 2—24 v. D.C. motor operators. 6—7.5 KV 400 amp. Gen. Elec. Type TA-101.

OUTDOOR DISCONNECTS: 18—7.5 KV 400 amp. Gen. Elec. Type FA-1. 9—15 KV 200 amp. Gen. Elec. Type FD103.

OUTDOOR BUS SUPPORTS: 18—33 KV tubular bus. .40—7.5 KV tubular bus.

Considerable quantity other disconnects, fused cutouts, bus supports, insulators, clamps & fittings—both outdoor and indoor. SEND US YOUR INQUIRY.

TRANSFORMERS
2—1000 KVA 13800/2300 1 ph. 60 cy Gen. Elec.

AIR COMPRESSORS
22"—14"x16" Ingersoll-Rand Imperial Type 10 with intercooler. Flat belt short center drive. Latest type channel valves. Horizontal, 2 stage.
20"—12"x14" Chicago Pneumatic Type O-CB with intercooler. Flat belt short center drive. Horizontal, 2 stage.

MOTORS
400 HP 1800 rpm 3/60/2300 Westinghouse synchronous
360 HP 330 rpm 3/60/2300 Gen. Elec. slip ring
200 HP 720 rpm any voltage Gen. Elec. synchronous
200 HP 1800 rpm 3/60/440 Gen Elec. slipring
200 HP 1800 rpm 3/60/440 Gen. Elec. slip ring
160 HP 1200 rpm 3/60/440 Century sq. cge
100 HP 900 rpm 3/60/2300 Gen. Elec. slip ring
100 HP 1800 rpm 3/60/2300 Westinghouse sq. cage
75 HP 1800 rpm 3/60/2300 Westinghouse slip ring
60 HP 1800 rpm 3/60/220-440 Westinghouse sq. cage
50 HP 720 rpm 3/60/2300 Gen. Elec. slip ring
50 HP 720 rpm 3/60/2300 Gen. Elec. sq. cage
Many other sizes in stock.

STEAM ENGINE GENERATORS
(2) 65 KVA Engberg 9x10 Vertical 327 rpm 175 lbs. ga. non-condensing 3/60/220

DIESEL ENGINE
350 HP 400 rpm Superior Type YLO 5-Cyl. 12½x15
Can furnish generator to your specifications.

MOTOR-GENERATORS
1000 KW 600 v. 514 rpm—1440 HP Syn. motor. Westinghouse
(2) 300 KW 600 v. 900 rpm— 450 HP Syn. motor. Westinghouse
105 KW 70 v. 1200 rpm— 160 HP 220/440 v. sq. cage motor. Century
75 KW 125 v. 1200 rpm— 125 HP sq. cage motor. Gen. Elec.
48 KW 30 v. 600 rpm— 75 HP sq. cage motor. Gen. Elec.
Also smaller sizes available.

CONDENSERS
(2) 725 sq. ft. C. H. Wheeler 2 pass shell & tube (NEW)

D.C. CARGO WINCH CONTROLLERS
(2) 50 HP 230 v. Class 8590 Westinghouse (NEW)

PIPE LINE PUMPING SETS
17000 bbl. 750 lbs. Goulds 3"—6 stage driven by 300 HP 400 rpm Superior diesel engine.—Falk speed increasor
27000 bbl. 720 lbs. Cameron 4"—6 stage driven by 400 HP 1800 rpm 2300 v. Westinghouse synchronous motor.

SPEED INCREASER
8.89/1 Falk 400/3550 rpm 350 HP

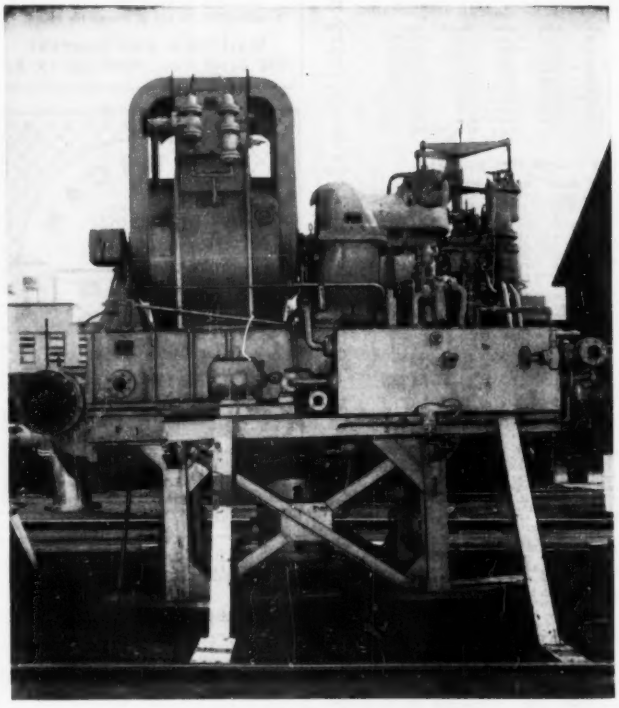
BOILER FEED PUMPS
375,000 lbs./hr. 720 lbs. Ingersoll-Rand 4"—6 stage with 400 HP 1800 rpm 2300 v. syn. motor
350,000 lbs./hr. 450 lbs. Goulds. Fig. 3360 4"—4 stage
225,000 lbs./hr. 750 lbs. Goulds. Fig. 3360 3"—6 stage

TAMPA ARMATURE WORKS, INC.

401 S. MORGAN ST. PHONE 2-1966 TAMPA, FLORIDA

POWER EQUIPMENT
FROM THE BOSTON METALS CO.

2 Modern Package Turbo-Generator Sets



PRESENTLY 2550 K.V.A.
2210 VOLTS. BUILT 1944

TURBINE: Westinghouse — serial 2-A-9593-99 and 2-A-9593-100. Impulse reaction type—7 stage condensing—3500 H.P.—W.P. 440 p.s.i. —Temp. 740°—exhaust 27½" vacuum—weigh 13,000 lbs. Built 1944. Max. r.p.m. 4950—normal 4800.

GENERATOR: Westinghouse 109S20P900 & 108S20P900. 2 pole type—3 phase—82.5 cycles—2210 volts—2550 K.V.A.

TURBO UNITS: Mounted above Westinghouse condensers. 2 pass 27,500 lbs./hr. — cooling surface 2200 sq. ft.—vacuum 27½" Hg—cooling water capacity 3400 G.P.M. — condenser temp. 109° F — set mounted on pre-fab sub-base. Built 1944.

Total Weight of Turbine, Generator & Condenser 56,250

UNITS CAN BE RE-CONNECTED FOR 60 CYCLE 3600 R.P.M.

1850 K.V.A.	*100% P.F.*	*1610 volts*
2100 K.V.A.	*100% P.F.*	*1540 volts*
1000 K.V.A.	*80% P.F.*	*1610 volts*
1200 K.V.A.	*80% P.F.*	*1510 volts*

WRITE • WIRE • PHONE

The BOSTON METALS Co.

313 E. Baltimore St. **CURTIS 5050** **Baltimore 2, Md.**

ELECTRICAL EQUIPMENT

REBUILT AND GUARANTEED

PROMPT SHIPMENT — PARTIAL LISTING

Electrical Equipment—Rebuilt and Guaranteed—Motors—Generators—M-G Sets—Transformers—Controls—Electrical Equipment—Rebuilt and Guaranteed—Motors—Generators—M-G Sets—Transformers—Controls—Electrical Equipment—Rebuilt and Guaranteed

800/1600 AMPERE ARC WELDING MOTOR GENERATOR SETS

Each set consists of two generators and one motor, mounted on base. Each Generator: Northwestern Type K28DR, 800 amperes, 50 volts, 1750 RPM. Motor: 125 HP, Allis Chalmers, Type AR, 2200 volts, 3 phase, 60 cycle, 1750 RPM.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
*	7½	810	550	G.E.	MTC-5291
2	10	1160	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
1	11½	870	550	G.E.	TTC-5008
2	15	1160	440	West.	CW-460C
2	15	870	220	West.	CW-646
1	18	580	440	West.	MW-316
1	20	880	440	West.	CW-628
1	25	1130	550	G.E.	MT-333
2	25	850	220	Wagner	BR
1	25	750	440	Wagner	22VBR
1	30	885	440	West.	CW-646
1	30	870	440	G.E.	MT-332
1	30	875	440	G.E.	MT-308
1	35	600	440	F-M	HV-H16A
2	40	885	2300	Al. Ch.	ARY-223C
1	40	580	440	G.E.	MT-340
1	50	1170	440	G.E.	MT-538
1	50	880	440	West.	HF-12A
1	50	570	440	G.E.	MT-552
5	52½	850	220	G.E.	IQC-5613***
2	60	885	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	585	550	West.	CW-958
1	80½	875	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTR-540
1	175	865	550	West.	CW-1002
1	200	885	2200	G.E.	IM-17A
1	250	600	2300†	G.E.	IM-17
1	300	900	440	G.E.	IM-17
2	300	1775	2200	G.E.	IM-17A
2	300	1775	2200	G.E.	IM-E15A
2	350	880	2200	G.E.	IM-17A
1	400	885	550	West.	CW
1	600	1775	440	G.E.	IM-E15C
1	700	735	4000††	West.	CW

220 volt motors can be reconnected for 440 volts. †Intermittent rating. **2 phase. ***New. ††25 cycle. *Also 440 or 2300 volts. †Also 440 or 550 volts.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding & Direct Connected Exciter.

Qn	KVA	RPM	Make	Volts
3	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qn.	Hp.	Speed	Make	Type
10	3	850	Reliance	T-257
28	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-66
1	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
8	10**	1150	Al. Ch.	ED-80
2	10	850	West.	SK-83
10	13½**	800	West.	SK-93
3	15	1750	G.E.	CD-75
2	15	625	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20**	1450	G.E.	CDM-83
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
1	20**	1450	G.E.	CDM-83
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1160	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	1750	West.	SK-150
1	50	850	G.E.	RC-16
1	150	700	Al. Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

Qn.	Hp.	Speed	Make	Type
1	5/7½	600/1800	G.E.	RA-50
1	10	400/1600	Reliance	T-927
1	12½	280/840	West.	SK-130
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RP-11
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RP-13
1	25	500/1200	G.E.	RP-12
1	33/29	500/1200	G.E.	RP-13
1	30/40**	400/1600	G.E.	CD-1238
1	35	600/1500	West.	SK-143
1	40/50	400/1200	West.	SK-163
1	75	500/1500	Cr. Wh.	CCM
1	75	375/750	Cr. Wh.	CMC-125B
9	100	225/900	G.E.	MPC-A
5	100	400/1200	Al. Ch.	
1	100	330/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	350/500	West.	SK-239
2	375	350/500	G.E.	MPC

**New

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
2	3	1160	440	L.A.	JS-254
4	5	1750	440	G.E.	K-254
3	7.5	1740	440	G.E.	K-284
1	10	1735	440	West.	CS-324
1	10	1165	440	West.	CS-326-EXP
1	10	1140	440	Wagner	CP2-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	60	3565	440	G.E.	KF-4058

SPLASHPROOF, BALL BEARING

Qn.	HP	RPM	Volts	Make	Type
1	3	1180	440	L.A.	FS-254
25	5	1750	440	L.A.	FS-284
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
4	15	1150	440	L.A.	FX-365
1	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335

OPEN TYPE MOTORS

Qn.	HP	Speed	Volts	Make	Type
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	PTR-512
1	20**	3475	220	West.	CS-326
1	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KT-512
2	20	1160	440	West.	CS-444C
1	20	900	220	G.E.	PTR-523
4	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-567C
1	25	900	220	Howell	RCBB-556***
1	25**	875	440	Master	PB-405
2	25	875	440	G.E.	KT-542
3	30	3550	550	G.E.	K-5048
1	30	1755	220	G.E.	PT-513
1	30	1160	440	West.	CS444
1	30	870	220	West.	CS446
1	40**	3545	220	G.E.	KP-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	PTR-536
4	50**	1750	440	Wagner	RPS-405
1	50	850	220	West.	CCL
2	60*	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-546
1	75	1160	440	West.	CS-663C
1	75	870	220	West.	CS-766A
2	75	885	2300	G.E.	KT-552B
1	100	890	220	West.	C
1	100	580	2200	G.E.	IK-15A
1	100	500	2200	West.	CS-930
1	100	495	2200	Al. Ch.	AN
1	125	435	440	Al. Ch.	AR
2	150	400	2300	G.E.	I-17-FR
2	175	400	2300	G.E.	KT-5648
1	200	580	550††	G.E.	CR-38A
2	300	587	2200	West.	CS-766C
1	500	1200	140	G.E.	KTP-587
1	700	1800	2300/ 4000	West.	CS-4-38D12

220 volt motors can be reconnected for 440 volts. **New. ***2 Phase. ††Reconnectable for 440 volts.

250 VOLT DYNAMOMETERS

Cradle Type With Scale and Control

Qn.	Make	HP	RPM	Type
1	G.E.	150	2200/5000	TLC-50
2	West	150	2200/5000	SK-151
1	G.E.	200	1200	C

MOTOR GENERATOR SETS

125 and 250 Volts D.C.

(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
3	Cant.	1750	125	220/440
7.5**	West.	1455	125	380/220†
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440†
16	West.	1750	125	2200/440
25	G.E.	1750	125	220/440
30	Al. Ch.	1750	125	220/440
50	G.E.	1720	125	220/3407
75	G.E.*	1200	125	220/380
100	West.	1180	125/250	2300/4100

Note: 5KW, 5KW & 7.5KW, 250V Sets Available.

**New. *Synch. Motor Driven. $50 Cy. 425 Cy.

For Immediate Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVENUE • CLEVELAND 14, OHIO

MOTOR GENERATORS

1—300 KW G. E. Syn. 250 V. 1200 RPM
1—300 KW WEST. Syn. 250 V. 1200 RPM
1—200 KW G. E. Syn. 250 V. 1200 RPM
1—200 KW RIDGWAY Syn. 250 V. 1200 RPM
2—150 KW G. E. Syn. 250 V. 1200 RPM
1—150 KW WEST. Syn. 250 V. 1200 RPM
1—100 KW RIDGWAY Syn. 250 V. 1200 RPM
1— 50 KW G. E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW G. E. Syn. 250 V. 1200 RPM
1—500 KW WEST. Syn. 250 V. 1200 RPM
1—300 KW WEST. Syn. 250 V. 1200 RPM
2—300 KW Al-Ch Syn. 250 V. 1200 RPM
1—150 KW G. E. Syn. 250 V. 1200 RPM
2—100 KW G. E. Syn. 250 V. 1200 RPM

ARMATURES

1—500 KW G. E. 250 V. Generator 500 RPM
1—300 KW G. E. 600 V. Converter 1200 RPM

WALLACE E. KIRK COMPANY
502 Grant Bldg., Pittsburgh 19, Pa.

AMERICAN

SINCE 1902
COMPRESSORS
VACUUM PUMPS
YOUR CHOICE:
American—Bury—Chicago—Curtis—Davey—Gardner Ingersoll—LeRoi—Penn—Schramm—Sullivan—Worthington

HEAR-HERE
American Rebuilts Are Best

AMERICAN AIR COMPRESSOR CORP.
Dell Ave., & 47th North Bergen, N. J.

COMPLETE DIESEL PLANT

3—Fairbanks Morse units 805 HP, 690 HP, 300 HP. 3/60/2400 volts. New 1940. Complete with operating auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

FOR SALE

GENERAL ELECTRIC FREQUENCY CHANGER SET

600 KVA, 3 phase, 120 cycles, 475 volts, type AT8-BL, frame 984Y, .65 PF, 1200 RPM, 1 bearing—with direct connected 5 KW, 125 volt exciter—connected to 800 HP, synchronous, 3 phase, 60 cycle, 550 volt, type TS, frame 9834, 1200 RPM, .8 PF, 2 bearing motor—with direct connected 5 KW, 125 volt exciter with G.E. starting reactor, type R-543 and panels for synchronous motor.

Call—MAIN 4-5900 • Write
EMPIRE ELECTRIC CO., INC.
87 Jay St. Brooklyn 1, N. Y.

POWER EQUIPMENT—READY TO SHIP

IMMEDIATE DELIVERY
AIR COMPRESSOR

1000 cfm Chicago Pneumatic 100# pressure 2300 or 440 v, A.C. syn. motor. Complete with starter and all accessories.

A.C. MOTORS
220/440 v. 3 ph. 60 cy.

HP	Make	RPM	Type
1000	Elec. Mach.	1200	syn.
500 New	Allis-Chal.	1750	drip proof
275	Westg.	380	2300 v.
250	G.E.	515	tefc. bb.
250	Burke	720	syn.
250	G.E.	1200	I-E
250	G.E.	1200	2200 v.
250 (5)	Westg.	1775	2300 v.
225 syn.	Elec. Mach.	1800	2300 v.
225	Elec. Mach.	1800	syn.
200	Westg.	291	CS
200	G.E.	430	tefc.
200	G.E.	860	2200 v.
200 (4)	Wagner	1750	RP-2
200	G.E.	1800	(2200 v.) syn.
175	Westg.	1000	M.S.
150	Westg.	257	syn.
150	G.E.	400	2300 v.
150	G.E.	400	tefc.
125	Westg.	600	syn.
150	Westg.	1200	CS-8758
150	Westg.	1200	MS
150	Elec. Mach.	1800	syn.
150	Elec. Mach.	1800	(2200 v.) syn.
125	Elec. Mach.	164	syn.
125 New	Westg.	1200	syn.
100	Fairbanks Morse	360	syn.
100	G.E.	1200	2200 v. tefc.
75	G.E.	690	I
75	Elec. Mach.	900	syn.
75	Louis Allis	1800	splash proof
60	Triumph	1200	
50	G.E.	720	KT
50	Triumph	840	B-133
50	Cr.-Wh.	900	
50 (3)	Westg.	900	CS
50 (3)	Westg.	1200	CS
50	G.E.	1200	KT-336
50 (2) New	Reliance	1750	2200 v. tefc.
40 (3)	Westg.	720	CS
40	G.E.	870	KT-546
40	Cr.-Wh.	720	
40	Westg.	900	syn.
40	G.E.	900	KT-336
40	G.E.	1200	KT
40 hi-torq.	G.E.	1630	KR-444
40	Allis-Chal.	1750	
40	G.E.	3600	FT
35	Westg.	690	
35	Allis-Chal.	1750	
30	G.E.	720	KR-444 hi-torq.
30	G.E.	860	KT-322
30 (7)	Allis-Chal.	1750	
30	G.E.	1750	
30 New	Louis Allis	1800/1200	
30 (2)	G.E.	3600	KT
25	Commonwealth	560	splash proof
25 (2)	Westg.	865	CS

SLIP RING MOTORS
3 Phase—60 Cycle

HP	Make	RPM	Volts
450	Allis-Chal.	293	2200
400	West.	435	2300
300	Cr.-Wh.	290	2200
200	West.	500	220/440
200	West.	500	2300
150	G.E.	600	2200
150	West.	870	2200
150	West.	870	220/440
100	Triumph	580	550/440/220
75	G.E.	600	550/440/220
75/150	West.	290/580	2300
75	G.E.	720	220/440
60	G.E.	570	220/440
60	Burke	1200	220/440
50	G.E.	570	220/440
50	Allis-Chal.	690	220/440
50	G.E.	900	220/440
50	G.E.	1200	220/440
40	G.E.	1200	550/440
35	G.E.	285	2200
35	West.	690	220/440
30	Allis-Chal.	575	220/440
25	West.	570	220/440
25	G.E.	690	220/440
15	Allis-Chal.	575	2200
15	G.E.	870	220/440

SPECIAL BARGAINS
Diesel Engine Generator Sets

2—100 kw., 120/240 v. D.C. Delco Generators dir. con. to 230 HP Model GBD-8, 5½x7, 8 cyl. Superior DIESEL Engines, elec. start with engine panels.

2—100 KW same as above with 220 or 440 v. NEW A.C. Generators.

10—37½ kva. 3 ph 60 cy. 127/220 v. or 220/440 v. 1200 rpm., Century A.C. Generators with dir. con. exciters driven by 70 HP., 4 cyl. Model UD-14 International Harvester DIESEL Engines with panels.

1—37½ kva., 3 ph. 60 cy. 127/220 v. or 220/440 v. Century 1800 rpm., dir. con. exciter driven by 72 HP., Model 6DTG317, Buda Diesel Engine with panel.

1—66 kva. Fairbanks Morse 220/440 v. 3 ph. 60 cy. 900 rpm DIESEL.

4—25 kva. 120 v. 1 ph. 60 cy. Westinghouse dir. con. to 35 HP., 4 cyl. 900 rpm., LaRoi Gasoline Engines with control panels.

5—25 kw., 220/440 v. 3 ph. 60 cy. Westinghouse direct connected to 4 cyl. LaRoi Gasoline valve in head liquid cooled Engine complete with control panels.

CLEANING MILL

1—Ransohoff Cleaning Mill 48" x 72", side loading side unloading, star return, with sand handling conveyor complete with tank, pump and motors.

GEARHEAD MOTOR

1—NEW 10 Hp., Westinghouse 220 v. 3 ph. 60 cy. 900 rpm., to 20 rpm type FD-3262F, frame W256 type CS.

VARIABLE SPEED MOTORS
230 Volt DC

HP	RPM	Make	Type
100	500/1000	West.	SK-190
100	625/1250	West.	—
50	750/1500	West.	SK-150
40	250/1000	West.	SK-141L
50	300/1200	Cr.-Wh.	CMC
40	385/1200	Elec. Mchy.	—
40	750/1500	West.	SK-140
40	575/1150	Al.-Chal.	E-145
30	725/1450	West.	SK-130
25	500/1500	West.	SK-110L
25	300/1200	G.E.	CD-123
20	400/1200	G.E.	RLE
20	500/1500	West.	SK-110L
15	300/1200	West.	SA
15	400/1600	West.	SK
10	500/2000	West.	SK-103
10	400/1600	West.	SK-83
7½	337/1350	Reliance	Exp. Pr.
7½	400/1600	West.	SK-70

FOUNDRY HOIST

3 Ton Robbins & Myers, 2 Motor, 220 Volt, 3 Phase, 60 Cycle.

MOTOR GENERATOR SETS

150 KW, Crocker Wheeler, 250 V. DC, 1750 RPM, 2200 or 550/440 Volt Syn.

150 KW, Crocker Wheeler, 250 V. DC, 1750 RPM, 2300 or 220/440 Volt Ind.

100 KW, Hobart, 250 Volt, 2200 Volt, 3 Phase, 60 Cycle, 1750 RPM Ind.

50 KW, West., 250 Volt DC, 1150 RPM, 220/440 Volt AC.

NEW ENGINES

75 HP, P&H, full Diesel, Model 387C, 1400 RPM, heavy duty, 3 Cylinder.

158 HP P&H, 6 Cylinder, full Diesel, Model 687C, 1400 RPM, heavy duty.

230 Volt DC Motors

HP	Make	Type	RPM
600	Cr.-Wh.	CCM	300/330
400	Cr.-Wh.	CCD	200
400	West.	—	800
160	Cr.-Wh.	CMC	1200
120	G.E.	DMC	300/750
100	West.	SK-190	800
100	West.	SK-141L	1700
60	West.	SK-153	850
60	West.	SK-132L	1750
50	Cr.-Wh.	CMC	700
50	West.	SK-150	750
40	Al. Chal.	EL-45	575
40	West.	SK-140	775
40	Cont.	No. Pr.	1750
30	West.	SK-90	1800
25	West.	SK-100L	1100
25	G.E.	CDM	1750
20	L. Allis	FNA	1750

250 Volt DC Generators

KW	Make	Type	RPM
500	Cr.-Wh.	CCM	375
275	West.	—	400
150	Burke	B-70	900
150	Cr.-Wh.	CMC	1450
100	West.	SK-100	720
100	Al.-Chal.	—	275
100	Delco	120/240	1200
75	West.	SA	750
60	West.	—	875
60	West.	SK	1150
50	West.	SK-150	1150

SPECIAL
25 Cycle Motors

3—15 HP, 1450 RPM, Louis Allis, 220/440 Volts, 3 Ph., Totally Enclosed, Fan Cooled, Ball Bearing, Frame 404, LIKE NEW.

TRANSFORMERS
1 ph. 60 cy.

No.	Kva	Make	Primary	Sec.
3	500	West.	22000	2200
3	200	Pgh.	22000	2200
2	150	Pgh.	4600	115/230
1	110	Pgh.	4600	115/230
6	100	Pgh.	4800	115/230
2	100	Allis-Chal.	4800	120/240
2	100	G.E.	4800	120/240
1	75	Pgh.	4600	115/230

BAKER LOCOMOTIVE CRANE TRUCK

Model CTA 3000 lbs. at 7' radius with 8 to 12'' adjustable telescoping boom complete with slow control, hoist control and boom control.

PUMPS

2777 GPM Fair. Morse Cent. 235' hd. 8" dis. 10" suc. 300 HP. A.C. Syn. Motor.

2083 GPM Fair. Morse Cent. 235' hd. 8" dis. 10" suc. 225 HP. A.C. Syn. Motor.

1382 GPM Fair. Morse Cent. 235' hd. dir. con. 150 HP. A.C. Syn. Motor.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

GOOD HYDRO-ELECTRIC GENERATING EQUIPMENT

Several alternators 4 and 5000 KVA 2300 volts 200 RPM

1 800 KW unit 450 RPM 2300 volt 210' head
2 horiz. 560 KW 300 RPM 2300 volt
1 horiz. 400 KW 180 RPM 2300 volt
1 vert. 144 KW unit 120 RPM 480 volt 10' head
2 Leffel scroll 15" wheels for 100-300' head
Many others all subject to prior sale. Low prices
Wm. C. MOULTON ASSOC., MONSON, MASS.

1—50 KW G.E. M.G. Set, 250 V. DC, Sync. 3/60/2300 V. AC.
1—200 HP West. CW Motor, 3/60/440/490 RPM.
1—100 HP New West. S.R. Motor, T.E.F.C. 3/60/440 V. 900 RPM & control.

TIPPINS MACHINERY CO.
Pittsburgh 6, Penna.

POWER PLANT EQUIPMENT
SPECIAL OFFERINGS

TURBO-GENERATORS

2—4000 KW, 2300 V., 150# Cond.
1—3500 KW, 4000 V., 150# Cond.
1—3000 KW, 4000 V., 150# Cond.
1—2300 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—2000 KW, 550 V., 175# Cond.
1—1500 KW, 2300 V., 200# Cond.
1—1250 KW, 2300 V., 250# N.C.
2—1250 KW, 2300 V., 225# Cond.
1—1000 KW, 2300 V., 175# Extr.
1—1000 KW, 2300 V., 250# Cond.
1—1000 KW, 4150 V., 250# N.C.
2—1000 KW, 480 V., 180# Cond.
1— 750 KW, 550 V., 170# Extr.
1— 500 KW, 2300 V., 165# Cond.
1— 300 KW, 2300 V., 150# Cond.
1— 150 KW, 2400 V., 150# N.C.

ENGINE GENERATORS

1—600 KW, 2300 V., Unit.
1—500 KW, 230 V., D.C., Unit.
3—375 KVA, 550 V., Unit.
1—312 KVA, 440 V., Unit.

DIESEL GENERATORS

1—1000 KVA, 2400 V.
3— 540 KW, 480 V.

BOILERS

1—30,000#, 425#
1— 1,000 HP, 250#
2— 500 HP, 200#
1— 438 HP, 200#
2— 300 HP, 250#
2— 250 HP, 200#
1— 150 Hp, 150# Sc. Mr.
1— 78" H.R.T., 200#

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

MOTORS - M.G. SETS - CONTROLS

NEW AND GUARANTEED REBUILT

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
650	138	2300	Whse.	Engine
400	900	2300	Whse.	80%
250	200	440	G.E.	85%
150	600	440	G.E.	100%
100	900	440	G.E.	100%
75	1200	440	G.E.	80%

SLIP RING

HP	RPM	Volts	Mfg.
700	514	2300	G.E.
500	1200	220/440	Elliott (new)
350	450	2300	Whse.
300	600	220	G.E.
200	450	2300	Burke
100	1160	440	G.E.
50	720	220	Whse.
50	900	220	G.E.
40	900	220	G.E.
7½	1800	220	Rel. (New)

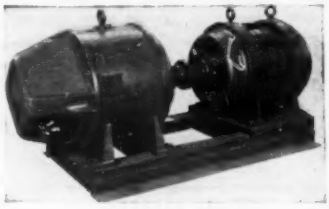
NEW DIRECT CURRENT

230 volt-drip-proof

Qu.	HP	RPM	Mfg.	Frame
1		890/2660	G.E.	284
10	5	850/1700	G.E.	CD-66
3	7½	575/1725	G.E.	CD-77
1	7½	1750	Rel. (TE)	14T
1	10	575/2300	L.A.	4051
1	30	300/1800	G.E.	CD-1377

CRADLE TYPE DYNAMOMETER

225 HP, Whse, 250 v. DC, 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.



M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	125/250	2300	Whse.
400	125/250	2300	Whse.
300	250	2300	Whse.
250	240	2300	G.E.
200	250	2300	Ridgeway
150	250	440	Whse.
125	250	2300	G.E.
100	250	2300	G.E.
75	125/250	220/440	Century
50	250	440	G.E.
40	250	220/440	G.E.
30	250	440	Ideal
30	125/250	2300/4000	G.E.
20	250	220/440	G.E.
15	230	220/440	G.E.
7½VS	250	220/440	Rel.
3VS	250	220/440	Rel.

230 V. DIRECT CURRENT

Reconditioned & Guaranteed

HP	RPM	Mfg.	Brgs.
200	415/1200	G.E.	Sl.
85/145	500/1100	G.E.	Ped.
100	450/1350	Whse.	Sl.
65	400/1200	Rel.	Sl.
50	500/1500	G.E.	Sl.
50	1800	Burke	Ball
40	400/1200	Rel (TE)	Ball
35	400/1200	Ideal	Sl.
30	250/1000	Whse.	S.Sl.
30	500/1500	C-W (TE)	BB
30	500/1500	Rel	Ball
25	250/1000	G.E.	Sl.
25	500/1500	C-W	Ball
25	600/1350	Rel	Ball
25	690	Rel	Ball
20	250/1000	Whse.	Sl.
20	30/1200	Rel.	Ball
20	500/1500	G.E.	Sl.
15	250/1000	G.E.	Sl.
15	400/1600	Whse.	Sl.
15	575/1725	L.A.	Ball
15	650/1650	G.E.	Sl.
15	700/1350	Rel	Ball
10	300/1200	Whse.	Sl.
10	400/1600	Rel	Ball
10	600/1200	Rel (TE)	Ball
10	850	Rel	Ball
10	1750	G.E. (TE)	BB
7½	200/1200	Whse. (TE)	Ball
7½	300/900	G.E.	Sl.
7½	400/1600	Rel	Sl.
7½	400/1600	Whse.	Ball
7½	600/1800	Rel (TE)	Ball
7½	1150	G.E.	Sl.
5	400/1200	C-W	Sl.
3	850/1700	Rel	Ball

Buy from BOSWICK with confidence

WAlbridge 1195

BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO

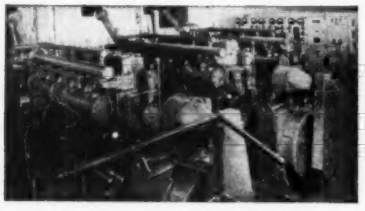
375 KVA - FOR SALE - 300 KW

WORTHINGTON-WESTINGHOUSE INSTALLATION

COMMERCIALLY UNUSED

•

IMMEDIATE DELIVERY



Each Plant consists of

3 Worthington Model BB 5—150 HP Diesel Engine Generating Units direct connected to Westinghouse Generators.

Rated 100 KW—125 KVA—3 phase, 60 cycle, 460 Volts, AC Current at 600 RPM.

Suitable for reconnection to 85 KW—3/50/230/400 at 500 RPM.

Complete with all accessories and auxiliaries including evaporative coolers—switchboard—distribution panel.

OWNED & OFFERED BY

KANE-McGUIRE COMPANY

Single units available

1492 East 32nd Street
Brooklyn, New York
PHONE: WHitehall 3-6843

STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Ebasco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, Sturtevant Induced Draft Fans, Smoke Stacks. Good for 250# pressure by Hartford.

1—705 HP Stirling 4 drum Boiler with B&W Superheater, Green Chain Grate Stoker, Sturtevant Economizers, Sturtevant Inducted Draft Fan, with Smoke Stack. Good for 250# pressure by Hartford.

2—8000 HP Webster Water Heaters.

1—McCaslin Pivoted Bucket Conveyor System for handling coal and ashes. Approximately 300' long.

6—Steel Coal Bunkers, 80 tons each.

1—20,000 sq. ft. Wheeler 2-pass Surface Condenser.

1—9,000 sq. ft. Westinghouse 2-pass Surface Condenser.

1—4"x6" Dayton-Dowd Centrifugal Pump direct connected to 125 HP General Electric-Curtis Steam Turbine.

1—Kennicott Pressure Type Industrial Water Filter.

1—50-Ton Electric Traveling Crane.

1—25-Ton Hand Operated Traveling Crane.

Send for complete Inventory

MORSE BROS. MACHINERY COMPANY

2900 BRIGHTON BLVD.
P.O. Box 1708, DENVER, COLORADO

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

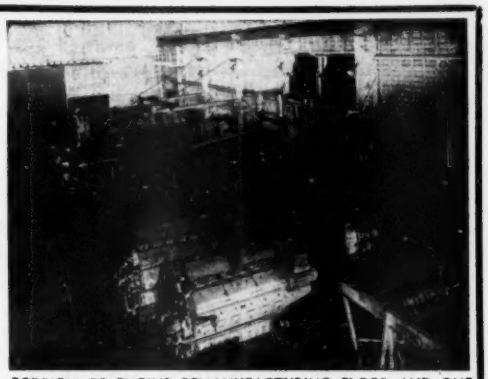
The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

A.G. SCHOONMAKER CO., INC.

52 CHURCH ST., NEW YORK 7, N. Y.
PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1500	Fairbanks Morse	33E16	2000	300
1230	Nordberg	F6G168SC	1750	327
1136	Fairbanks Morse	38D	1600	720
1000	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
500	Alco	6-12-1/2x13T	750	600
500	Worthington	EE	750	327
500	General Motors	8-567	720	720
340	Baldwin	VO-6	510	450
320	Buckeye	80	480	600
300	Enterprise	DSG-6	450	450
300	General Motors	8-268A	450	1200
264	Superior	KNA	396	514
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
100	General Motors	3-268A	150	1200
100	Worthington	8B-5	150	600
60	General Motors	6-71	90	1200
50	Caterpillar	D-8800	76	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

Most all units still on foundation. Many may be seen operating

DIESEL UNITS

1000 KVA Elliott-DeLaverne
815 KVA EM-Worthington EE5
594 KVA Elliott-Cooper Bessemer
550 KVA EM-Worthington EE8
375 KVA Fairbanks-Morse 32E14
250 KVA Fairbanks-Morse 32E14
250 KVA GE-Buckeye-E
187 KVA GE-Buckeye-E
175 KVA Fairbanks-Morse 32E14
125 KVA (2) Elliott-Buckeye
125 KVA GE-General Motors
90 KVA Fairbanks-Morse 32E14
75 KVA (2) General Motors
50 KVA (2) Fairbanks-Morse 42F
225 HP Buckeye (belted)
180 HP Fairbanks-Morse (belted)
128 HP (4) Caterpillar (belted)
120 HP Fairbanks-Morse 32E
120 HP Superior (belted)

GAS ENGINE UNITS

750 KVA Elec. Mchy.—800 HP Worthington Nat. Gas

BOILERS

427 HP Bigelow 3 dr. 200#
395 HP Union 3 dr. type L, 300#
370 HP Wicks Cr. drm. (2) 300#
333 HP Bigelow 3 drm. 250#
309 HP Combustion 3 dr. 160#
255 HP (2) Combustion 200#
220 HP (2) Vogt 3 dr. 160#
Three 250 HP HRT 150#
125 HP (2) Erie City Economic 150#

TURBO GENERATOR UNITS

3750 KVA Wghse. 3/60/600 v; bleeder
1250 KVA GE 3/60/480 v; bleeder
937 KVA Wghse. 3/60/480 v; bleeder
750 KVA Al.-Chal. 3/60/480 v; cond.
2800 KVA GE 3/60/2300 v; non-cond.
250 KVA GE 3/60/600 v; non-cond.
187 KVA GE 3/60/480 v; non-cond. 375#
SURFACE CONDENSOR 4000 Sq. Ft. Wghse.

ENGINE-GENERATOR UNITS
3/60/480/240 v.

312 KVA GE-Skinner unit.
250 KVA (3) Elec. Machy.—Skinner unit.
187 KVA Wghse.-Ames vertical
62 KVA GE-Ames Unit.

Above listed units are only a few of our "SPECIALS." Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
400	G.E.	I-M	1200	S. B.
300	G.E.	I-M	1200	S. B.
200	G.E.	I-M	1200	S. B.
150	G.E.	I-M	1200	S. B.
150	G.E.	I-M	1800	S. B.
100	G.E.	MT-368	1800	S. B.
100	G.E.	I-M	900	S. B.
100	G.E.	I-M	720	S. B.
75	G.E.	MT-343	1200	S. B.
75	G.E.	I-M	900	S. B.
75	West.	CW	720	S. B.
75	G.E.	I-M	720	S. B.
60	G.E.	MT-333	1800	S. B.
40	G.E.	I-M	1800	S. B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
150	G.E.	K-6326	3600	TEFCBB
150	G.E.	K-8326	1800	TEFCBB
125	G.E.	K-6326	1200	TEFCBB
100	West.	CS-6075	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	AMZ	1800	TEFCBB used
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open
75	F.M.	QS-445	1800	B. B. open
75	West.	CS-585	1200	TEFCBBXP
60	West.	CS-5048	1800	TEFCBBXP
60	G.E.	K-5045	1800	TEFCBBXP
60	L.A.	HB-44	1800	B. B. open
60	F.M.	QS-444	1800	B. B. open
50	Master	FB-404	3600	TEFCBBXP
50	G.E.	K-445	1800	TEFCBB
50	G.E.	K-405	1800	S. B. drip
50	West.	CS-445	1200	S. B. open
50	G.E.	K-508	900	TEFCBBXP
40	A.C.	AAR-444	3600	TEFCBBXP
40	G.E.	KF-3658	3600	B. B. splash
40	West.	CS-405	1800	TEFCBB
40	L.A.	K-408	1800	TEFCBBXP
40	G.E.	404	1800	B. B. open
40	Cr. Wh.	SC-445	1200	TEFCBB
30	G.E.	KF-3658	3600	B. B. splash
30	West.	CS-3658	3600	S. B. splash
25	Line.-Weld	DBD-328	3600	B. B. open
25	West.	CS-384	1800	S. B. splash
25	G.E.	K-364	1800	S. B. drip
20	G.E.	K-384	1800	S. B. drip
20	L.A.	EX-364	1800	TEFCBBXP
20	G.E.	KF-404	1200	TEFCBBXP
20	G.E.	KG-405	900	TEFCBBXP
20	G.E.	KF-405	900	TEFCBBXP
15	L.A.	EX-326	1800	TEFCBBXP
10	West.	CS-264Z	3600	TEFCBB
10	Howell	EKBB-28-5	1800	TEFCBBXP
10	Reliance	AA-CB-324	1800	TEFCBB
10	West.	CS-324	1800	TEFCBB
10	West.	CS-324	1800	B. B. open
10	L.A.	EX-326	1200	TEFCBBXP
10	G.E.	K-364	900	S. B. drip
10	L.A.	R-1638	600	TEFCBB
3	G.E.	K-224	3600	TEFCBBXP
3	L.A.	EX-223	1800	TEFCBBXP
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-607	1200	S. B.
75	G.E.	KT-552	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25R	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.
50	G.E.	KT-342	900	S. B.
50	G.E.	KT-346	900	S. B.
40	G.E.	K-444	1800	B. B.
40	G.E.	KT-323	1800	S. B.
40	West.	CS	1200	S. B.
40	G.E.	KT-336	900	S. B.
40	F.M.	B-H12D	900	S. B.
40	G.E.	KT-542	720	S. B.
35	Triumph	B-12	900	S. B.
35	G.E.	I-L	900	S. B.
35	G.E.	I-K	720	S. B.
30	G.E.	KT-312	1800	S. B.
30	West.	CS	1200	S. B.
30	G.E.	KT-332	900	S. B.
25	G.E.	KT-312	1800	S. B.
25	West.	CS-471	1800	S. B.
25	Century	SC-30	1200	S. B.
25	G.E.	I-K	720	S. B.
25	F.M.	B-H12-B	720	B. B.
20	West.	CS-364	1800	S. B. splash

SQUIRREL CAGE MOTORS REBUILT

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
200	Wagner	HP-2-26	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-564	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.

We have in stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM.
We also carry in stock a large quantity of used electric motors from 1 HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER EQUIPMENT COMPANY

8 CAIRN STREET — P. O. BOX 534 — ROCHESTER 2, N. Y.

Telephone: Genesee 5629

BOILERS—TURBINES

1—Erie City—3 drum, bent tube water tube boilers, 1940, rated 29,000# steam per hour, each, can produce 42,000# steam per hour each, with water walls. Rated 500 HP each at 250# steam pressure, complete with oil burners and trim.

1—Combustion Engineering, 3 drum, bent tube, low head, water tube boiler, 1943. Rated 20,000# steam per hour, 400 HP at 185# steam pressure, complete with stoker and controls, valves etc.

1—Unused 140,000# per hour Combustion Engineering Steam Generator, V U Type, 450# steam pressure.

Also:

2—750 HP B & W straight tube boilers, 225# to be released soon.
3—600 HP B & W straight tube boilers, 200# to be released soon.
Various package units from 25 HP to 500 HP various pressures.

We also carry power and distribution transformers, switch gear, including potential and current transformers, circuit breakers etc.; also steam turbines, all sizes and pressures.

WE BUY ENTIRE CENTRAL AND POWER STATIONS

HOWE BROTHERS

342 MADISON AVENUE — MUrray Hill 2-8562 — NEW YORK 17, N. Y.

TRANSFORMERS

SINGLE PHASE—60 CYCLES (unless otherwise stated)

Qty.	KVA	Make	Type & Form	Prim. Volts	Sec. Volts
4	500	PITTS. (25 CY.)		6600	440
1	500	GE (3 PH)		4160	120/208
1	300	PITTS.		2875	230/199/115
1	200	WEST.	SK	13200/6600	2300
4	200	PITTS.		4150	460
2	200	WEST.	S	2400/4160	600
1	200	MOLONEY		575/460	230/115
1	150	PITTS	ODSC	13200	2300
11	150	WEST. (3 PH)		13530/13200/12870	208/120
15	150	WEST. (3 PH)		13750/13400/13063	216/125
34	150	GE (3 PH)	HT—R	13750/13400/13063	216Y/125
51	100	GE	H—KRW	14375/14015/13665/13295/12935	216Y/125
37	100	GE	H—VR	13750/13400/13063/12720/12375	216Y/125
46	100	WEST.	SK	13750/13400/13063	230-120
3	75	WEST.		2400/4160Y	120, 240
38	50	WEST.	SK	13750/13400/13050	250/125
57	50	WEST.		2730/2386/2321/1962/1927/1802/1375	110/220

(AIR COOLED)

MANY OTHERS IN STOCK—YOUR INQUIRIES WILL RECEIVE OUR PROMPT ATTENTION
EMPIRE ELECTRIC COMPANY, INC., 87 Jay Street, Brooklyn 1, N. Y.—MAin 4-5900

OPPORTUNITIES!

in

New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

Send for new list . . . to

EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE
Two Rector St., New York 6, N. Y.

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—15630 KVA G.E. Cond. 60 cy. 13200 V. 275-lb.
1—10000 KVA G.E. Cond. 25 cy. 6600 V. 200-lb.
1— 6250 KVA Allis Cond. 60 cy. 4000 V. 175-200 lb.
1— 5000 KVA West. Extr. Cond. 60 cy. 480 V. 385-lb.
1— 4375 KVA G.E. Cond. 60 cy. 2300 V. 200-lb.
1— 3750 KVA G.E. Cond. 60 cy. 2300 V. 185-lb.
1— 2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lb. 40-lb. BP
1— 2500 KVA G.E. Extr. Cond. 60 cy. 480 V. 185-200 lb. Steel Valve Chest
2— 2250 KVA G.E. Cond. 60 cy. 240-400 lb.
1— 1875 KVA West. Cond. 60 cy. 2300 V. 170-lb.
1— 1875 KVA G.E. Cond. 60 cy. 2300 V. 180-lb.
1— 1563 KVA G.E. Extr. Con. 60 cy. 2300 V. 200-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
1— 938 KVA G.E. Extr. Cond. 60 cy. 240 V. 200-lb.
1— 938 KVA West. Extr. Cond. 60 cy. 2300/4100 V. 200-lb.
1— 750 KVA G.E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.
2— 250 KVA Elliott Non-C. 60 cy. 208 V. 200-lb. 5-lb. BP

DIESEL ENGINE UNITS

1—1600 HP Fair. Morse 2300/4150 V. 60-cy.
1—1000 HP Superior 2300 V. 60 cy.
1— 900 HP Amer. Loco. 250 V. DC
3— 650 HP Amer. Loco. 440 V. 60 cy.
1— 250 HP Buckeye 240 V. 60 cy.

STEAM ENGINE UNITS

1—675 KVA Chase Corliss 2300 V.
1—250 KVA Ames Vertical Uniflow 480 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

ROTARIES — 60 CY.

QU.	KW	MFR.	VOLTS-DC	TRANS.	RPM
1	3250	G.E.	225/260	13000	500
3	1600	G.E.	600	13200	900 Auto.

SYNCHRONOUS CONDENSERS

QU.	KVA	MFR.	VOLTAGE	RPM
1	2500	G.E.	2400/4160	720
1	2000	West.	2300	720
1	1500	G.E.	4000	900
1	1500	West.	2300	900

SPECIAL

1—150 HP, General Electric synchronous motor starter, cubicle type, type CR-7811, across-the-line, reversing dynamic braking.

MERCURY ARC RECTIFIERS

QU.	KW	KIND	DC VOLTS	TRANS.
2	4500	Multi Anode	600	13800
4	3250	Ignitron	650	33000
1	1000	Multi Anode	600	13800

MOTOR GENERATOR SETS — 60 CY.

QU.	KW	MFR.	VOLTS-DC	A.C.	RPM
1	2000	G.E.	600	4000	450
1	1000	G.E.	600	13200	514
1	500	West.	125	2300	720
1	400	G.E.	250	6800	720
1	75	West.	125	440	1200

SYNCHRONOUS MOTORS — 60 CY.

QU.	KVA	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
2	1750	G.E.	2200	3600
2	700	West.	2300	200
1	600	G.E.	2300	1000
1	600	G.E.	440	360
2	350	G.E.	2300	257
1	300	G.E.	2300	600
1	300	West.	2300	900
1	113	West.	440	1200

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	5000	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	3000	G.E.	60/25	300
1	2500	G.E.	25/62½	750
1	2450	G.E.	62½/25	750
1	1700	West.	60/24	720
1	1500	G.E.	25/62½	750
1	1250	G.E.	25/60	300

TRANSFORMERS — 60 CY.

1—	7500 KVA G.E.	138000—41000, 3 ph.
3—	3333 KVA West.	132000—7620/13200 Y
3—	1000 KVA West.	66000—23000/2300/4000 Y
3—	500 KVA G.E.	66000—2400
1—	2500 KVA G.E.	59/73 KV—5 taps, 3 ph.
4—	2500 KVA West.	44000—11000
3—	1500 KVA Wag.	44000—6900 NEW
3—	250 KVA Mel.	44000/22000—440/220
3—	75 KVA West.	44000—7200/12470
3—	8333 KVA West.	43800—13000
3—	100 KVA Wag.	38000—7200/12470 Y
1—	18750 KVA A.B.B.	34840—11000, 3 ph.
6—	1500 KVA Pitts.	33000—2400
3—	200 KVA West.	33000—7200/12470 Y
3—	200 KVA West.	33000—2400
3—	167 KVA G.E.	33000—2300/4000 Y
6—	150 KVA G.E.	34500—2300/4600
4—	150 KVA G.E.	33000—7200/12470 Y
3—	100 KVA A.C.	33000—7200/12470 Y
3—	75 KVA Mel.	33000—2300/6900
3—	75 KVA Wag.	33000—7200/12470 Y
6—	50 KVA G.E.	33000—2300
4—	450 KVA A.C.	25410/44000—13280/23000
4—	750 KVA Wag.	19650/33000 Y—6900/11950
3—	200 KVA G.E.	11500—220/110
3—	200 KVA Mel.	11000—2300
3—	150 KVA Mel.	7620/13200 Y—120/240
3—	667 KVA Kuhl.	7200/12470 Y—2400
4—	50 KVA G.E.	7200/12470 Y—2300
4—	100 KVA G.E.	6900/11900—2400
3—	37½ KVA G.E.	6900/11900—2400
3—	75 KVA West.	6600—460/230
1—	100 KVA G.E.	2300—575, 3 ph.
3—	15 KVA Stand.	450/225—117

OIL CIRCUIT BREAKERS

4—600 A. 154 KV G.E. FHKO-39-2500	Outdoor
1—600 A. 73 KV G.E. FHKO-236-500	Outdoor
1—400 A. 37 KV G.E. FHKO-136-350	Outdoor
1—400 A. 37 KV West. O-221-500	Outdoor
1—400 A. 15 KV G.E. FKO-37-40	Outdoor
4—600 A. 15 KV G.E. FHKO-139-750	Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW-WOLTMAN & CO., INC.

50 Church Street — New York City 7, — WOrth 4-1470

BOILERS

100,000 lbs per hr., 250#
87,000 lbs per hr., 350#
600 HP Sterling, 200#

TURBINES

4000 KW., 300# Bleeder Type, Condensing
2500 KW., 225# Non-Condensing

DIESEL PLANT

1200 KVA (in 3 units) 514 RPM, 440 V.
1100 KW (in 2 units) 327 RPM, 480 V.

GENERATOR

3500 KW, 3/60/2300 V., 3600 RPM, Rewound. Completely overhauled.

STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave. New York 33, N. Y.

MOTORS—M.G. SETS—COMPRESSORS, ETC.

M.G. SETS & CONVERTERS

KW	MAKE	RPM	D.C.	A.C.
750	Al. Ch.	720	250	440
500	West. Rotary	1200	250	2300
400	West.	720	550	2300
300	GE	1200	250	230C
300	GE Rotary	600	250	2500
300	West.	1200	250	2300
500 (2)	Al. Ch. Rotary	1200	250	2300
300	West.	1200	550	2300
150	GE	900	550	2300
150	West. Rotary	1200	250	2300
50	G.E.	1200	250	2300

A.C. MOTORS

HP	MAKE	RPM	TYPE
400	GE	450	Sl.Rg.
300	GE	450	Sl.Rg.
150	GE	900	Sq.Cg.
150	GE	600	Syn.
100 (2)	Allis	720	Sq.Cg.
100	West.	900	Syn.
100	West.	1200	Sq.Cg.
100	GE	1750	Sq.Cg.
100 (2)	GE	450	Sl.Rg.
75	West.	900	Sq.Cg.
75	GE	600	Sl.Rg.
60	West.	600	Sl.Rg.
50	GE	1750	Sq.Cg.
40	GE	900	Sl.Rg.
40	West.	900	Sq.Cg.

AIR COMPRESSORS

350 CFM Chg. Pb. 12"x10" NSB 100#.
415 CFM Allis Rotary 100#.

MOORHEAD ELECTRICAL MACHINERY COMPANY Pittsburgh District
361 Noblestown Road (Est. 1919) Oakdale, Penna.

SELLING FOR CUSTOMERS

2—100 KVA, 1 phase 60 cycle 2400 to 240/480 Pyranol trans.
1—50 1—100 & 1—150 KW M.G. Set 220/440 AC to 250 DC
1—375 KVA Westinghouse nonsond. turbine set.
1—37½ KVA 240/480 Diesel set.
What do you need—What have you to sell—Make use of our nation-wide service when buying or selling equipment.
H. BLANE JOHNSON & ASSOCIATES
53 W. Jackson Blvd., Chicago 4, Ill.

FOR SALE

Power plant equipment. Steam. Diesel. electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

IMMEDIATE DELIVERY —2-ea. 60,000# hr. capacity 4-Drum Stirling type, 250# psi, (10,000 sq. ft. H.S.) 525° F.TT Boilers. Condition excellent, suitable any fuel, now oil fired.

1—48,000# hr. capacity Boiler, otherwise same as 60,000# (8,500 sq. ft. H.S.) above boilers.

768 HP B&W Sterling Boiler, 200#, with new tubes & superheaters.

● We have many other boilers in sizes of 250 to 600 HP, 200 to 450# pressure. See our September Power ad.

Turbo-Generators, Condensing, 300 to 10,000 KW.
Turbo-Generators, Non-Condensing, 200 to 2500 KW.

TRANSFORMERS! Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed.

Frequency Changers
Motor-Generators & Diesel-Generators

Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK — **30 CHURCH ST.** — **NEW YORK 7, N. Y.**

PARTIAL LISTINGS OF EQUIPMENT AVAILABLE FOR YOU

SYNCHRONOUS MOTORS
3 Phase, 60 Cycles

HP	RPM	VOLTAGE	DESCRIPTION
10	1200	220	Wagner
15	1200	440	Wagner
15	1800	220	Wagner
20	600	220	E-M (rotor & stator only)
20	900	220	Westgh.
20	1200	440	Wagner
25	450	220	E-M (rotor & stator only)
25	1800	220	Wagner
30	327	220	E-M (rotor & stator only)
30	360	550	G.E. (rotor & stator only)
30	450	220/440	Westgh. (rotor & stator only)
30	600	550	G.E. (rotor & stator only)
30	900	440	Wagner
50	300	220/440	Westgh. (rotor & stator only)
50	720	440	G.E.
50	1200	220/440	Delco, one brg.
60	360	220	E-M (rotor & stator only)
60	360	2200	G.E. (rotor & stator only)
75	1200	220/440	Delco—Single Brg.
75	1200	220	Westgh.
85	1200	220	Burke
100	1200	220	Westgh., Single Brg.
100	1800	2300	Westgh.
115	164	208	G.E.
120	225	220	E-M (rotor & stator only)
150	900	220/440	Star
150	1200	220	Westgh.
150	1800	220	G.E., single brg.
160	164	440	Ft. Wayne (rotor & stator only)
160	600	440	G.E.
175	225	208	G.E. (rotor & stator only)
200	150	220	G.E. (rotor & stator only)
220	277	2300	Westgh.
225	900	4160	G.E.
250	225	2200	G.E.
300	720	4000	G.E.
300	1800	2300/4160	G.E., 3 brg.
320	900	2300	G.E.
350	900	440	G.E.
425	720	2300	G.E.
500	514	440	G.E.
735	600	12000	G.E.

D.C. GENERATORS
115 Volts

KW	RPM	DESCRIPTION
¼*	1450	Delco, BB-TE
½*	1750	Delco, BB-TE
½	2100	G.E.—CQ, series
2	1400	Westgh.
2	1700	Westgh., TE-BB
3	1800	W-E, CD
7½	1750	Imperial
9	400	Fairbanks-Morse
9	1650	G.E.—pedestal Brg.
9½	950	G.E.—CVC
10	1200	Delco, single Brg.
10	1165	Westgh., SK93, BB
15	780	Burke
15	1100	Allis-Chalmers
15	725	Electro Dynamic, 1 Brg.
15	1200	Robbins & Myers
15	3600	G.E.—BB
19	1150	G.E.—CD93
20	1200	Allis-Chalmers, 1 Brg.
22.5	1100	Westgh.—SK, single Brg.
23	1800	G.E.—BC31B
25	1200	G.E., DLC25
50	1500	Star, BB
55	1000	G.E.—TD
100	900	Westgh., Fed. Brg.
100	1000	W-E, DLC
300	1200	G.E.
300	1500	G.E., single Brg.

* New

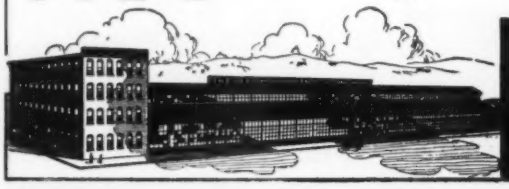
D.C. GENERATORS
230 VOLTS

KW	RPM	DESCRIPTION
1.15	3100	S-H type CQP
2	1750	Allis-Chalmers
2	1750	Reliance, BB
15	250/1125	G.E.—CD
15	750	Westgh.
15	1750	Allis-Chalmers
18	500	Burke
20*	1750	Westgh., SK93, BB
22½	765	Westgh., SK120
25	425	Westgh., SK170
50	500	Triumph
50	900	Electro Dynamic, BB
55	1800	G.E.—BC21B
50	800	C-W, CMC
125	600	Westgh.
175	450	Westgh.
200	900	CW- CCD
200	1200	G.E., MPC
400	1200	Westgh., Single Brg.

* New

SPECIAL

General Electric Copper Oxide Rectifiers, D.C. Output 500 Amp., 6 volts, A.C. Input designed for 440 volts, 3 phase, 60 cycle. New Rectifier Stacks.



GLOW ELECTRIC CO.
927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

STOKERS

2—Combustion Engineering Company Type EHP—Class 10—size 10'3"—516 HP Stokers—New 1942—Run about two years at normal rating. Good condition.

COAL SCALE

1—Richardson 200# EE Automatic Coal Scale. New 1942. Used about two years.

COAL CONVEYORS

1—34 ft. section 11" Ridler loop boot elevator with reducing gear and V belt drive. New 1942. Used about two years.

1—25 ft. section Underwood Heavy Duty 24" belt conveyor with reducing gear. New 1942. Used two years.

W. F. SCHRAFFT & SONS CORP.
CHARLESTOWN, MASS.

MOTORS — SQUIRREL CAGE
220 or 440 Volts

Qu.	HP	MFR.	Type	Speed
1	15	A.C.	AR	1200
1	15	G.E.	I	900
1	15	Whse.	CS	720
1	15	G.E.	IK	720
1	20	G.E.	KF	1800
1	20	Wag.	15VRP	1200
1	20	G.E.	KT	1200
1	25	G.E.	KT	1800
1	25	G.E.	KF	1800
1	25	G.E.	IK	1200
2	25	G.E.	KT	900
1	25	G.E.	K	900
1	25	G.E.	IK	600
1	30	Whse.	CS	1200
4	30	F.M.	H	1200
1	30	G.E.	KT	900
1	30	W.E.	CS13B	720
1	35	G.E.	IK	1800
6	35	A.C.	AR	450
1	40	Whse.	CS	1200
1	40	Whse.	CCL	600
1	50	G.E.	KT	1200
1	50	A.C.		900
2	50	Whse.	CCL	600
1	75	Whse.	C	600
1	150	F.M.	O	1800

SLIPRING

1	1½	G.E.	M	1080
1	15	G.E.	ITC	815
1	20	G.E.	MT	1200
1	150	Whse.	CW	1800
1	200	A.C.	ANY	1800

Rebuilt & Guaranteed

SOUTH TEXAS MACHINERY CO., INC.
4300 DIXIE DRIVE
HOUSTON 21, TEXAS

NEW B&W 475# BOILERS. 1000-1800 HP Immed. shipment—will sacrifice.
STRUCTURAL STEEL BLDGS WITH CRANES. 160-200 70 by 200 50 by 60.
CRANES 10 ton to 75 tons. Span to suit you.
AIR COMPRESSORS. 4000—3000—1200—800—500 cu. ft.
H. A. WOODWORTH ENG. CO.
311 OLIVE ST. LOUIS MAIN 1071

PULVERIZER
B. & W. E-26 Class 221B
5000 pounds per hour
55 Grindability
UNUSED
MERRILL and COMPANY
407 So. Dearborn St. • Chicago 5, Illinois
Telephone: HArrison 7-8289

TURBO GENERATORS

3 Phase 60 Cycle

15,625 KVA G.E. condensing, 250 lbs., 500° FTT, 13,200 volts.

12,500 KVA Allis condensing, 225 lbs., 550° FTT, 13,200 volts.

6,250 KVA Allis condensing, 200 lbs., 500° FTT, 2300/4000 volts.

5,000 G.E. non-condensing extraction, 600 lbs., 750° FTT, 125/150 lbs. extraction, 0-50 lbs. exhaust, 13,800/4000 volts.

5,000 KVA G.E. condensing, 200-400 lbs., 750° FTT 2300/4000 volts.

4,000 KVA Allis condensing, 200 lbs., 500° FTT, 2300 volts.

3,750 KVA G.E. condensing, 150-250 lbs., 500° FTT, 2300/600 volts.

2,500 KVA G.E. condensing, 150 lbs., 500° FTT, 2300 volts.

2,500 KVA G.E. condensing extraction, 200 lbs., 550° FTT, 20 lbs. extraction, 480 volts.

1,875 KVA G.E. condensing, 150-250 lbs., 650° FTT, 2300 volts.

1,250 KVA G.E. condensing, 200-400 lbs., 650° FTT, 2300/4150 volts.

1,250 KVA Westg. condensing extraction, 150-200 lbs., 600° FTT, 5-25 lbs. extraction, 480 volts.

625 KVA Westg. non-condensing, 150-200 lbs., 600° FTT, 5-25 lbs. exhaust, 480 volts.

625 KVA G.E. condensing, 400 lbs., 650° FTT, 4160/2300 volts.

UNIFLOW UNITS

3 Phase 60 Cycle

750 KVA Ames-Allis Chalmers vertical, 150 lbs. steam, 5 lbs. exhaust, 2400/4160 volts.

625 KVA Skinner-G.E., 150 lbs. steam, 5 lbs. exhaust, 240 volts.

500 KVA Skinner-G.E., 125 lbs. steam, 5 lbs. exhaust, 480 volts.

375 KVA Ames-Westg. vertical, 200 lbs. steam, 3 lbs. exhaust, 2300 volts.

312 KVA Skinner-G.E., 150 lbs. steam, 3 lbs. exhaust, 480 volts.

SPECIAL

750 KVA Vertical Uniflow Unit.

750 KVA Allis-Chalmers generator, 3 phase 60 cycle, 2300/4160 volts, 277 RPM direct connected to Ames 4 cylinder vertical uniflow steam engine, 125-150 lbs. steam pressure, 0-5 lbs. back pressure, 277 RPM. Complete with belt driven exciter, electric speed changer and all auxiliaries as in operation. New 1932—Excellent condition.

BOILERS

540 HP Keeler, 250 lbs. steam, pulverized fuel or oil fired.

350 HP Keeler, 250 lbs. steam, stoker fired.

225 HP (2) Union Iron Works, 200 lbs. steam, stoker fired.

200 HP B. & W., 10,000 lbs. per hour, 425 lbs. steam, stoker fired.

DIESEL GENERATORS

3 Phase 60 Cycle

1250 KVA (2) General Motors 2300 volts, 720 RPM.

1000 KVA DeLaVergne, 2400 volts, 200 RPM.

880 KVA Worthington, 480 volts, 327 RPM.

750 KVA General Motors, 2400 volts, 720 RPM.

695 KVA Fairbanks-Morse, 2400 volts, 300 RPM.

546 KVA Worthington, 480 volts, 327 RPM.

312 KVA Superior, 480 volts 360 RPM.

RECTIFIERS

4,500 KW Allis Chalmers Mercury Arc Rectifiers (2) 600 volts DC, 3 phase 60 cycle, 13,800 volts AC.

1,000 KW G.E. Mercury Arc Rectifier, 600 volts DC, 3 phase 60 cycle, 13,200 volts AC.

HIGH FREQUENCY GENERATORS

3 Phase 240 Cycle

2,860 KVA (3) New G.E. AC generators, Type ATB, 3 phase, 120/240 cycles, 4150 volts, 4800 RPM.

INTERNATIONAL POWER MACHINERY CO.

1609 UNION COMMERCE BLDG. Telephone: MAin 1-9514 CLEVELAND 14, OHIO

DIESEL GENERATOR UNITS

AC and DC

Quick Delivery and Complete Installation with all Equipment

LIEFKE, 57-25 Cooper Ave.

Brooklyn 27, N. Y. HEgeman 3-4335

---

480 HP BUCKEYE

Diesel engine, 8 Cyl., Model 80, 600 RPM, late type. Rebuilt.

GENERAL MOTORS DIESEL Set

600 KW, 500 Volt, Model 12,567.

ALJON ELECTRIC DIESEL CO.

904 Pacific St. B'klyn 16, N. Y.

STerling 3-6515

IN STOCK FOR IMMEDIATE SHIPMENT

NEW and REBUILT MOTORS

GENERATORS • M. G. SETS • TRANSFORMERS

Write, Wire, or Phone Your Requirements • Cash for Your Surplus

PREFERRED *Electric Motors Inc.*

230 HUDSON AVE., P.O. BOX 767, ROCHESTER 3, NEW YORK • HAmilton 3420

TRANSFORMERS—60 cycle

3—1250 KVA, A. Ch., 4800/460—3 ϕ

3—1250 KVA, A. Ch., 4160/460—3 ϕ

1—2500 KVA, A. Ch., 4800/460—3 ϕ

1—2500 KVA, A. Ch., 4160/460—3 ϕ

1— 667 KVA, A. Ch., 4160/460—3 ϕ

12—1250 KVA, G. E., 13200/440—1 ϕ

12—1250 KVA, G. E., 13800/440—1 ϕ

12—1250 KVA, G. E., 7200/12470Y/440 1 ϕ

2— 750 KVA, Gen. E., 11000/480; 3 ϕ, 25 cycle

3— 150 KVA, G.E., 12000/240/480, 1 ϕ

1— 500 KVA, Scott Bank 2200, 3ϕ—pri. 220/440 2 ϕ

1— 100 KVA, Wagner, 480/120/240—1 ϕ

1— 325 KVA, Furn. 2300/4600/125—1 ϕ

1— 100 KVA, A. Ch., Furn. 440/110/80/60—1 ϕ

3— 75 KVA, A. Ch., 33000/2300/4160—1 ϕ WH. SW. GR.

2—75 KVA Gen. Elec. type H, OISC, 4160/4600, 230/460, 1 Phase

M.G. SETS

1000 KW, A. Ch. 250 V. DC, 1400 HP, 3 ϕ, 25 cycle. Or will consider changing motor for 60 cycle. Complete with switchgear.

200 KW, A. Ch., 125 v. D.C.; Mtr. 300 HP 3/30

40 KW—1000 amp., 40 V—DC mtr. 7 SHP 3/60

60 KW—1500 amp., 40 V—DC, mtr. 100 HP 3/60

100 KW, 125 volt D.C. mtr. 150 HP, 3/60

30 KW, 125 V D.C. mtr. 50 HP 3/60

FREQUENCY CHANGERS:

KVA—465 25/60 cy. or 60/25—3 ϕ RPM 300 Motor 650 HP, 3 ϕ, 300 RPM with sw. gear

1—200 KVA Gen. Elec. 25 cyle to 62½ cycle. 750 RPM, Motor 300 HP, 25 cycle, complete with panels

1—120 KW, 25/62½ cycle, 3 ϕ 720 RPM. Motor 200 HP 3/25/720 RPM

3— 20 KVA, G.E., 60/180 cycles 3 ϕ

3— 30 KVA, G.E., 60/180 cycle 3 ϕ

3— 25 KVA, G.E., 60/120 cycle 3 ϕ

1— 15 KVA, G.E., 60/120 cycle 3 ϕ

SQUIRREL CAGE MOTORS

3 phase, 60 cycle

HP	Make	Type	RPM	Volts
150	G.E.	IK14	1200	2300
100	A. Ch.	S.C.	690	440/550
100	G.E.	IK17	400	220/440/2300
150	G.E.	IK17	514	220/440/2300
75	G.E.	IM S R	600	220/440/2300
75	G.E.	IK	400	220/440/2300
75	West.	CW S R	1200	2300/440/220
50	A. Ch.	ANY SR	900	220/440
40	Star	BB S R	900	220/440
40	G.E.	IK	900	220/440
100	G.E.	IK	1800	220/440
200	G.E.	KT 25 cyc.	750	220/440
200	West.	CS 25 cyc.	750	220/440
150	C. Wh.	25 cycle	480	2300/440/220

1—G.E. 3 pole switchgear 3700 volt 400 amp.

1—400 amp. 3 pole 15000 volt breaker G.E. FK132A

VOLLAND ELECTRIC EQUIPMENT CO., INC.

Subsidiary Co.—Buffalo Transformer Co.

1500 NIAGARA ST. BUFFALO 13, NEW YORK

MOTORS • GENERATORS • TRANSFORMERS

7x7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type 5L. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

T.E.F.C. MOTORS

60 HP Westinghouse CS-607 3/60/440/900 X-Proof

50 HP Ideal New. 3/60/220/440/1800

2—20 HP Louis Allis ES. 365 3/60/220/440/1800 X-Proof

15 HP Louis Allis EX-364 3/60/220/440/1800 X-Proof.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheel 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy. 2400/4160 pri. 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

TRANSFORMERS FOR SALE

1 Phase, 60 Cycle

3—500 KVA G-E 66000—2300

2—500 KVA W-H 13200—240/480

3—400 KVA W-H 13200—600/575/550

3—333 KVA G-E 44000—6600

3—250 KVA W-H 13800—2300

3—200 KVA G-E 13200—120/240

3—150 KVA G-E 44000—33000—2400/500

3—100 KVA G-E 33000—6900/11950Y

3— 50 KVA A-Ch 33000—2400/4160Y

3-Phase, 60 Cycle

2— 750 KVA W-H 13800—460 DRY

1—4000 KVA W-H 1500/12750 Auto

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.

CINCINNATI 27, OHIO

REDUCED VOLTAGE COMPENSATORS

MANUAL—220 Volts

Quan.	H.P.	Make	Type	Condition
23	15	G.E.	1034K1	NEW
2	30	West	E	Rebuilt
1	20	G.E.	1034K1	NEW
1	25	G.E.	1034K1	NEW
1	25	West.	—	Rebuilt
2	30	G.E.	1034K1	NEW
1	50	G.E.	1034K1	NEW
1	100	G.E.	1034K533	NEW

MANUAL—440 Volts

Quan.	H.P.	Make	Type	Condition
15	15	G.E.	1034K1	NEW
20	20	G.E.	1034K1	NEW
23	25	G.E.	1034K1	NEW
35	30	G.E.	1034K1	NEW

MANUAL—2200 Volts

Quan.	H.P.	Make	Type	Condition
3	50	G.E.	1034P1A	NEW
5	60	G.E.	1034P1A	NEW
1	75	G.E.	1034P11Y	Rebuilt
5	75	G.E.	1034P1A	NEW
1	150	AL-Ch.	BD-30	Rebuilt
3	150	G.E.	1034P1A	NEW

MAGNETIC—220 Volts

Quan.	H.P.	Make	Type	Condition
3	7½	West.	11-400	NEW
2	40	G.E.	7051B1A	NEW
20	40	G.E.	7051C1F	NEW
20	50	G.E.	7051C1F	NEW
11	100	G.E.	7051D1F	NEW
1	100	West.	11-400	Rebuilt

MAGNETIC—440 Volts

Quan.	H.P.	Make	Type	Condition
2	10	West.	—	Rebuilt
2	10	West.	11-400	NEW
4	15	West.	11-400	NEW
5	15	West.	—	Rebuilt
2	20	West.	—	Rebuilt
1	25	West.	11-400	Rebuilt
1	25	West.	11-400	NEW
9	200	G.E.	7051D1F	NEW
1	200	West.	11-400	Rebuilt

ADDITIONAL RATINGS AVAILABLE

SANDMAN Electric

SANDMAN ELECTRIC CO., INC.

165 OLIVER ST., BOSTON 10, MASS.

SALES & SERVICE Tel. HUbbard 2-6750

ELECTRICAL CABLE

- for every industrial and power application
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

UNIVERSAL WIRE AND CABLE CO.

2668 N. Clybourn Ave., Chicago 14, Ill.

FOR SALE

MODERN 1000 KW Turbo-Generator

In Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.

6101 Tacony St. Philadelphia 24, Pa.

2—500 HP Sectional Header WT Boilers
2—450 HP Vogt 4-drum 200# oil fired
2—Rotary Dryers—6x45' & 5x35' oil fired
2—250 KW & 540 KW Engine—Gen. Sets
1-5 Ton Elec. Hoist—BRAND NEW
2—150 & 35 KW Westge. Motor Gen. Sets
1—125 HP FM 900 RPM New BB S. Rg. Motor

H. & P., 6719 Etzel, St. Louis 14, Mo.

260 H. P. DIESEL ENGINE

Liquidation Sale—Twin 6—71 General Motors model 12103. Heavy duty reduction gear to 900 R.P.M. With starting batteries and silencers. A standby unit used 4500 hours.

MARTIN J. HANSON TRUSTEE

1500 N. KOSTNER AVE. CHICAGO 51, ILL.

This Seal JLHP ...tells you what you buy is GOOD EQUIPMENT!

GUARANTEED GOOD BECAUSE REBUILT AND TESTED UNDER SUPERVISION OF

HEMPHILL ELECTRICAL ENGINEERS

TRANSFORMERS—60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
3	1500	Whse.	Hipersil	3	66000/33000 pri., 240/480 sec. w/Taps
3	1500	Pitts.			22000 pri., 2200 sec., w/Taps
1	1500	GE	Pyranol	3	4150x2300V
1	500	Kuhl.	OISC	1	4600x2300V
3	400	GE	H	1	6900x2250V
1	300	Pitts.	ODSC	1	7800x440V
1	200	GE	HT	3	2300x220
1	200	Whse.	Auto	3/2	4150x2300
1	200	Pitts.	OISC	1	4000x110/220
1	200	GE	Auto	3/2	4150x2400
1	150	GE	KB	1	2300x230
1	100	Pitts.		1	2750x110/220
3	100	Wagner	RCKV	1	240x120/120
2	100	Whse.	SK	1	4400x220/440 Taps
3	50	Whse.	Interteen	1	2400x120/240

SPECIAL—WELDING MOTOR GENERATOR SET
1—176 KVA Whse. Welding Gen. Set, 1 Ph. 20V, 800 Amp 57% PF with Slip Ring Motor & Exciter

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED DC	AC
1	1000	GE	514 600	2300/4150 Syn.
1	300	GE	1200 250	2300 Syn.
1	200	Whse.	900 250	220/440 Syn.
1	150	GE	1200 125/ 250	2300 Syn.
1	150	Whse.	600 125	4150 Syn.
1	125	CW	1200 125	2300 SC
1	100	CW	1200 125	220/440 SC
1	100	El. Mach.	1200 125	4150 Syn.
1	94	GE	1200 60	440 SC
3	94	GE	1200 60	4150 Syn.
1	75	Cr. Wh.	1200 250	4150/2300 syn.
2	40	El. Mach.	1750 125	440 SC

SYNCHRONOUS

300 HP El. Mach. 720 RPM 2300 V T E F C. outdoor Service
200/100 HP Whse. 720/360 RPM 4150 V.

SLIP RING

1	2500	GE	MT	6600	257
1	250	Whse.	CW	440	600
1	200	GE	MT	2300	1800
1	200	Whse.	CW	440	600
1	200	GE	MT	440	600
1	100	GE	TW	440	400
1	75	GE	MT	220	1200 Vert
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1300

Member of The National Industrial Service Association, Inc.

FOR POWER
J. L. HEMPHILL & CO.

TURBO-GENERATORS
2000 K.W., 3 ph., 60 cy., 150 lbs G.E.
1000 K.W., 3 ph., 60 cy., 250 lbs G.E.
750 K.W., 3 ph., 60 cy., 250 lbs extract. G.E.
500 K.W., 3 ph., 60 cy., 150 lbs G.E.
150 K.W., 250 v., new Westgh., D.C.

DIESEL UNITS
62½ KVA., 3-60—Caterpillar
37½ KVA., 3-60—Ready Power
100 K.W., 250 v., D.C. Superior Deico

UNUSED PUMPS & MOTORS
Union Steam Co., pumps all 250 ft. head with new Louis Allis motors, 1750 RPM
1—200 GPM, 30 HP motor
1—400 GPM, 50 HP motor
1—500 GPM, 75 HP motor
1—900 GPM, 100 HP motor

TRANSFORMERS
3—200 KVA Westgh., 11500 x 480 V.
7—100 KVA Gen. Elec., 11000 x 2200 V.
3—100 KVA Meloney 11400 x 2200 V.
2—100 KVA Gen. Elec., 2400 x 120—240 V.
4— 50 KVA Gen. Elec., 11000 x 2300 V.
2— 50 KVA Westgh., 13800 x 230—460 V.

3 PH., SLIP RING MOTORS
425 HP., Gen. Elec. MT414Y, 382 rpm.
200 HP., Gen. Elec. 1M.—585 rpm.
200 HP., Westgh., CW., 1750 rpm.
200 HP., Gen. Elec., 1M., 435 rpm.
150 HP., Gen. Elec. 1M., 1800 rpm.
150 HP., Gen. Elec. 1M., 514 rpm.
100 HP., Reliance AWG085—600 rpm.
100 HP., Gen. Elec. 1M—570 rpm.
100 HP., Gen. Elec. 1M—585 rpm. Also 75 HP down

SQUIRREL CAGE & SYN.
300 HP., Gen. Elec., syn, 257 rpm.
250 HP., Burke syn, 360 rpm.
200 HP., Gen. Elec. KT550, 1150 rpm.
100 HP., Westgh., Syn, 900 rpm.
100 HP., Gen. Elec. KT543, 1800 rpm.
100 HP., Elec. Mchy. syn, 360 rpm.
90 HP., Gen. Elec. syn, T87552, 900 rpm. Many smaller sizes

We carry a large stock of all kinds of direct current motors etc. What have you for sale? What do you need?

KEYSTONE POWER PLANT EQUIPMENT CO.
8403 Hegerman St. Phila. 36, Penna.

Immediately Available — STEAM TURBINE

One 1250 KW Steam driven turbo-generating set, complete with surface condenser, air ejector, circulating and condensate pumps with driving motors and controls.

Turbine Steam Consumption 200 #/hr
100° F. superheat steam at throttle
1250 KW 14.92# steam/KW hr. at .8 P.F.
2300 Volts 3600 RPM

Three Spray Type DEAERATING HEATERS
64,000# per hour

One 61 HP KEWANEE BOILER
Model 582—100#

Complete, ready to use, coal or oil burning.

SPECIALTIES ENGINEERING CO.
Seaboard Trust Building, Hoboken, New Jersey
Phones—HOboken 3-4427, REctor 2-9362

FOR SALE: 2—Steam Engine Generator Sets
ENGINES: Skinner Uniflow. GENERATORS: Westinghouse 375 KVA, 220 Volt, 3-60.
Complete with panels and all accessories. Boilers also available.
ANDREN MYERSON CORP.
411 ATLANTIC AVE. Liberty 2-4300 BOSTON, MASS.

40000 Foot Cable, Parkway Hazard—3 cond. #2 Standard, for 2300 V

CABLE — SWITCHES — LIGHT PLANTS
FITTING — LINE POLE EQUIPMENT
TRANSFORMERS — COMPLETE INVENTORY

CABLES

1200 Ft. cable Parkway #40, 3 cond. Type RR 600 volt.
1500 Ft. cable, 4 cond #6 Type W, 600 volt.
1000 Ft. cable, 4 cond #4 Type W, 600 volt.
73,000 Ft. Wire, #4 7 strand, Type TW.
31,000 Ft. Wire, #8 solid, Type TW.
3500 Ft. Wire, outside Telephone, #14 Twisted pairs.

220- 440- 2300-VOLT EQUIPMENT

CIRCUIT BREAKERS

6 Breakers, Air Circuit, I.T.E. Circuit Breaker Co., Phila.—Type KB "Urelite", 600 amp., 480 v., 3 pole.

ELECTRIC MOTORS

1 Motor, Electric—Westinghouse 200 HP. Slip Ring Motor. Type CW8735—440 3 phase, 60 cycle—1175 RPM. B.B., splash proof. Style 1B6655, shaft extension both ends. Serial No. 1S1B6655.

1 Motor, Electric—Wagner Electric Corp. 150 H.P., Type R51, Frame 35Y, Model 1E5BZ27, RPM 575, 440 volt, 3 ph., 60 cycle, 193 amp. Serial No. B7C841.

1 Motor, Electric, Wagner Electric Co., 150 H.P., Type R51, Frame 35V, Model 1E5-BZ27, RI 575, 440 v., 3 ph., 60 cy., Serial Nos. C7C-1561.

CONTRACTORS POWER EQUIPMENT and SUPPLIES

TRANSFORMERS

57 Transformers, Inductive Equipment Corp., 5 KVA, 2300/480/240 volt, Dry type, single phase. Type E-C.

20 Transformers—Inductive Equipment Corp., 5 KVA, 3 ph., 2300/480/240 v., 60 cycle, dry type. Type FCT, spec. 1187MC1170. Serial Nos. 1317 to 1336, incl.

9 Transformers, General Electric 5 KVA, Cat. 60G177, Dry Type, single phase, 60 cycles, 2400/480/240V.

LIGHTING PLANT

1 Electric Plant, Onan, 10 K.W. Model WC10S, 1800 RPM. Serial No. 829156., A.C.—115/230 V., 44 amp., 60 cy., 1 ph., D.C.—28V., 25 amp.—Generator No. 21132. Hercules engine, Model 1XB5, Size 3¼ x 4., Serial No. 691560.

BATTERY CHARGING UNITS 10KW—20 KW—25 KW—30 KW

PUMPS AND BLOWERS—116 PUMPS FOR ALL PURPOSES. Sludge, deep well, circulating, gathering, grouting, air and suction 1000 C.P.M. 1000 ft. hd., 1800 ft. head 500 G.P.M., 500 G.P.M. 1000 ft. head. 14 High Low Pressure Blowers in excellent condition.

LURIA BROTHERS and COMPANY, INC.

EQUIPMENT DIVISION
BALTIMORE FIELD OFFICE RT.26 RANDALLSTOWN, MD. P.O. BOX 440: Phone ROslyn 1406
LINCOLN LIBERTY BUILDING PHILADELPHIA, PA. Phone Rittenhouse 6-7455

TURBO-GENERATORS

250 KW, 300 KW A.C. and D.C.

2000 KW 3 phase, 50 cycles, 6300 volts

Immediate delivery

Packed in original crates
Complete Specifications and Details Upon Request

INTERNATIONAL FERMONT MACHINERY CO., INC.
115 BROADWAY
NEW YORK 6, N. Y.

SQUIRREL CAGE MOTORS

125 HP GE 3/60/440V/1800 KT547/#5235285
200 HP GE 3/60/220V/900/K564/B.B. 5519486 W/Clark magnetic comp. Bul. 5900.
350 HP C.W. 3/60/2300V/3550 RPM #1196851

SLIP RING MOTORS

30 HP GE MT342 3/60/220V/720/#4002427
40 HP GE MT346 3/60/220V/900/#4012815
50 HP West. C.W. 3/60/220V/1175/#2249500
100 HP GE 1-16 3/60/220V/430/Type 1-16/#1578989
500 HP GE 3/60/2300V/900 RPM/#5275932

SYNCHRONOUS MOTORS w/CONTROLLERS

75 HP West. 3/60/220V/1200 RPM Sealed Sleeve Brg. w/Dir. Con. Exc. Ser. #4710832
125 HP El. Mach. 3/60/4800V/900 RPM Ball Brg. w/Dir. Con. Exc.
135 HP GE 3/60/4000V/1200 RPM/T5963Z
175 HP Burke 3/60/2200V/720 RPM w/Dir. Con. Exc.

MULTI-ARC WELDING M-G SETS

24-GE 1500 Amp. Synch. driven w/AC & DC Panels

DIESEL ENGINES
TURBINE GENERATORS—M-G SETS

4-New Hercules 135 HP Mod. DWXD
250 KVA Elliot Turbo Gen. 3/60/208V 1200 RPM/ Equal to Unused
100 KW GE Alt. 3/50-60/1500-1800 RPM Type ATI/2 Brg. 4 Wire w/Dir. Con. Exc. Unused
2—100 KW Buckeye AC 3/60/2200V/400 RPM
1—200 KW Buckeye AC 3/60/2200V/400 RPM

ALBERT HELLER CO.
210 Snediker Ave., Brooklyn 7, N. Y.

MONORAIL HOIST COMPLETE

4 ton bucket hoist—3 motor high speed, with 2-4 wheel swivel trucks and Williams standpace bucket with safety catches
Coke Bucket
Hoisting cables

SPARE PARTS FOR HOIST

40 H.P. 440 volt 3 phase motor
30 HP. 440 volt 3 phase motor
Torque motor 440 volt
Miscellaneous small parts

Available Immediately

Contact Gas Superintendent

WISCONSIN MICHIGAN POWER COMPANY
APPLETON, WISCONSIN

BOILERS

10 to 1000 H.P.
NEW-USED
RECONDITIONED
Steam, Gas and Electric Power Equipment
J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY

BOILERS—TURBINES—ENGINES

Boilers 50-2000 HP; Turbo Gen. 100-6000 KW St. Eng. Gen. 75-1000 HP — *Write for our Free New List of High Grade Used Equipment.*

BENJAMIN W. BISSELL, Reg. Engineer
610 K of P Building, Indianapolis 4, Ind.
Phone: Lincoln 4007

FOR SALE

2—Late 2000KW GE Turbo Generators 400 PSIG
2—Late 4000 HP Sync. Motors—257 RPM
1—Rotary Compressor 60000 CF/M 4 lbs press.
Switchboard equipment, oil circuit breakers, current transformers etc.

Utility Equipment & Construction Co.
216 So. LaSalle Street, Chicago, Ill.

100 KW GENERATOR SET

BUCKEYE DIESEL 400 RPM 3/60/240 with V-Belted exciter, Switchgear, Voltage Regulator, Oil filter, Silencer, Water Pump. Engine overhauled.

Immediate delivery—Priced to Sell

ROBERT L. NEISWANDER
Hollywood, Fla. Tel 9476

MOTORS—M. G. SETS—TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1	400	G.E.	IK	2200	514
1	400	G.E.	KT-412	2200	435
2	300	Whse.	CS-890	2300	1750
1	200	Whse.	CS-873C	2200	1160
2	200	ALCh.	AR	440/220	580
1	125	ALCh.	AR	2200	1750
1	125	Whse.	CS-761C	440/220	1750
1	125	C.W.	126-Q	440/220	430
2	100	Whse.	CS-663C	440/220	1750
1	100	G.E.	IK	440/220	1800
1	100	ALCh.	AR	2200	1160
1	100	ALCh.	AR	550	690
1	100	F.M.	H241B	440/220	435
1	100	Whse.	CS-938	2200	495
1	78	G.E.	I-K15	440/220	570
1	75	ALCh.	AR	2200	1765
1	75	ALCh.	AR	2200	1750
1	75	ALCh.	AR	2200	690
1	50	G.E.	KT	440/220	1160

SYNCHRONOUS MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	PF	Volts	RPM
1	3000	Whse.	80	4800/2400	720
1	700	G.E.	80	2300	720
1	600	Whse.	80	2400	720
1	400	Whse.	80	440	600
1	300	Whse.	80	440	514
1	150	G.E.	100	2200	900
1	150	G.E.	100	550/2200	600
1	150	G.E.	80	550/2200	450
3	125	E.Mchy.	100	4800/2400	900
1	125	G.E.	80	2200	900
2	100	Whse.	80	440/220	1800
1	100	Whse.	100	2200	1200
1	100	Ideal	80	220/440	900
2	100	G.E.	80	220/440	600

SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1**	3000	G.E.	MT	2200	356
1**	1200	C.W.	SR	2200	257
2**	1000	Al.Ch.	ANY	2200	235
1**	600	G.E.	MT-20	2200	360
1**	400	Al.Ch.	ANY	2200	514
2	500	G.E.	I-16-M	2300	450
2	400	G.E.	MT-412	2200	450
1	300	G.E.	I-15-M	2200	1200
1	300	Al.Ch.	ANY	2200	514
1	250	Al.Ch.	ANY	440	585
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I-16-M	2200	585
1	150	G.E.	I-13-M	2200	1750
1***	125	Whse.	CW-670	2200	870
1	100	F.M.	H20C	440/220	900
1	75	G.E.	5M	440/220	695
1	75	Whse.	CW-7540	440/220	690

**Mill type pedestal bearing. ***3 bearing.

MOTOR GENERATOR SETS

Qu	KW	Make	RPM	Volts DC	Volts AC
1	2400(3-U)	Al.Ch.	720	525	4800/2400
1	2400(3-U)	Whse.	720	600	4800/2400
1	1500	Whse.	514	250	4600/2300
1	1000	G.E.	514	550	2300
1	500	C.W.	720	250/275	2300/440
2	500	C.W.	720	575	2300/440
1	250	Whse.	1200	125/250	2300
1	200	Ridgway	900	275	2200
1	155	G.E.	720	250	2300/440
1	150	G.E.	1200	500	2300/440
1	100	C.W.	1200	125	440/220
1	100	Delco	1200	125/250	440/220
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	2300/440
1	75	Star	1200	230	440/220
1	75	Al.Ch.	900	250	2300
1	75	Whse.	900	75	2200
1	25	Ideal	1750	125	220
1	20	Al.Ch.	1200	250	440/220
2	15	Al.Ch.	1200	250	440/220
1	15	G.E.	1200	250	440/220
1	10	Whse.	1200	250	440/220

3-U — 3-unit set.

We can furnish any of the above sets with exciters and VARIABLE VOLTAGE CONTROL engineered and rebuilt for your requirements.

TRANSFORMER — Power

Qu	KVA	Make	Type	Phase	Voltage
1	2760	G.E.	DH	3	6900-240/480
3	500	Whse.	S	1	13800-2400
4	333	G.E.	H	1	13200/11000-2200
3	250	Packard	A	1	13200-2200
3	130	G.E.	H	1	19000/9500-550/2200
3	100	G.E.	H	1	33000-2300
3	100	Whse.	SS	1	12075/10955-230/460
3	50	Al.Ch.	O.I.S.C.	1	22000-220

DIRECT CURRENT MOTORS

Qu	HP	Make	Type	RPM
1***	3000	Whse.	Encl.(Rev.)	600
1***	2400	Whse.	Encl.(Rev.)	600
4***	1800	Whse.	Encl.(Rev.)	600
4***	1200	Whse.	Encl.(Rev.)	600
4***	800	Whse.	Encl.(Rev.)	600
1	350	G.E.	CD-189	1150
1	325	Whse.	QM-660.6	450/900
1	200/250	El.Dy.	422	400/120
1***	200	G.E.	MPC	500/1200
1	200	Whse.	MIII	300/1200
1	300	Whse.		240/300
1	180	G.E.	MPC	400
2*	150	C.W.	82-H	800
1***	125	Whse.	SK-190	600
2	125	Whse.	SK-184	575/850
1	100/125	Rel.	1095-F	300/1200
2	100	Rel.	1050-T	400/1200
1	90/160	G.E.	MPC	625/1125
1*	50/75	Rel.	1095-F	300/1200
1	35	G.E.	RF-14	500/1500
1	35	G.E.	CD-125	400/1200
1	35	G.E.	CD-147	300/1200
1	35	Rel.	36P	250/1000
1	32½	Whse.	SK-150	400/1200
1*	30/75	Whse.	SK-151L	400/1200
1	30	Al.Ch.	E-145	400/1200
1	30	G.E.	CDM-105	875/1750
2	27½	El.Dy.	158	450/1350
1	25	G.E.	RF-13	400/1600

All above 230-VDC except where marked ***.
*** Pedestal bearing mill design 525/600-VDC (Rev.) Designed for mill reversing service.
* T.E.F.C.

T. B. MAC CABE COMPANY

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.

IMMEDIATE DELIVERY

Stoker C.E. 8 Retorts Continuous Steam Dump—14' W x 14' 8" L, 205.8 sq. ft. Used 6 Months.

80 H.P. 125# Package Powermaster Boiler. Combination light, heavy oil and gas. New.

12,500# steam per hour, 160# pressure, Bros 2-Drum water tube boiler, trim, outlet valves, header. Todd heavy automatic oil burner. Westco Boiler Return Condensate System. Used 6 months. New Guarantee.

150 H.P. Cyclotherm with return system. 125# pressure 4 years old. Light Oil.

25,000 to 30,000# new 2-Drum Bros Water tube boiler 250# pressure. 90 days.

AUTOMATIC COMBUSTION EQUIPMENT CO., INC.

P. O. Box 1478 — Rochester 3, N. Y.

WATER TUBE BOILERS

Union Iron Works Horizontal Straight Tube

2—259 H.P., single drum

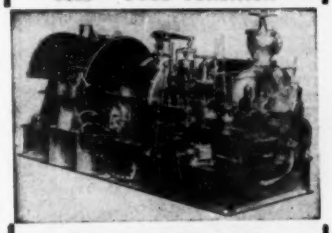
2—350 H.P., two drum

First-class condition
Immediate delivery

JAMES T. CASTLE CO., INC.
534 FIRST AVE.
PITTSBURGH 19, PA.

FOR SALE TURBO GENERATORS

USED — GOOD CONDITION



GE 200 KW 120V
ALSO AVAILABLE:
132 KW, 200 KW, 500 KW, 3/60/450 AC

•

1500 HP DC MOTORS WESTINGHOUSE

•

1200 KW DC GENERATORS —ALLIS CHALMERS

•

DIESEL DIVISION
NATIONAL METAL & STEEL CORP.
Dept. P, Terminal Island
(Los Angeles Harbor), Calif.
Phone Los Angeles: Nevada 6-2517

SPECIAL TRANSFORMERS—YOUR SPECIFICATIONS

NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGES

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

FOR SALE—1000 KW 1250 KVA ALLIS-CHALMERS GENERATOR

600 Volt, 3-phase, 60 cycle, 300 RPM

ANDREN MYERSON CORP.

411 ATLANTIC AVE. — Liberty 2-4300 — BOSTON, MASS.

TRANSFORMERS

60 Cy. Single and 3 Phase

KVA	Make	Voltages—Pri. Volts	Voltages—Sec. Volts
7500(2)		33000	6900/13800
3000(1)		2300	80/110
2500(3)		27,600	2300
2000(3)		46,000	2300
1500	GE	2300	600
1250	GE	13800	575/600
1000	GE	66000	7200/7025
1000	West.	2200	220
1000		33000	2300
1000		13800	240/480
750		13800	2300
750	GE	2300	2/3 ph. 2300
667(2)		6900	2300
667(3)		6900	230/460
500		4160	120/208
500		4600	460
500	West.	12000	480/240
500		4600	230/460
500	GE	4160	480
500	GE	2400	240/480
500	GE	34500	230/460
450	GE	23000	445
450	Uptegraff	11000	460
400	GE	2400	480
400(2)		2300	3 ph. 230
333	GE	4150	120/240
333	Packard	2400	480
300	Pitts.	2300	115/230
250	Pitts.	4600	460
250	GE	460	216Y/125
250	Pitts.	2400	600
250	West.	2400	460
250	West.	463	
250	West.	13800	230/115
200	Moloney	630	220/110
200	West.	13200	2300
200	GE	4158	240/120
200	GE	495	120/240
200	GE	2200	122/244
200	Penn.	2400	480
200	Moloney	2480	230/460
200	West.	2300	600
200	Pitts.	2300	600
200	GE	11500	460
200	West.	3984	115/230
200	GE	6900	2400
150	Packard	4600	230/115
150	GE	2400	240/480
150	Pitts.	13200	2300
150	GE	2400	600
150	Standard	2300	230/460
150	GE	13800	115/230
150	West.	2400	240/480
150	GE	2400	240/480
150	GE	2200	110/220
150	Pitts.	7200	115/230
150	GE	4150	120/240
125	West.	440	440
125	West.	440	440
125	Al. Ch.	440	220/110
100	Pitts.	4800	230/115
100	Al. Ch.	6600	2300
100	Pitts.	13200	6900/11950Y
100	Uptegraff	4160	40
100	Pitts.	2100	110/220
100	Wagner	3830	115/230
100	West.	13200	220/440
100	Moloney	2200	110/220
100	GE	460	115/230
100	GE	18490	2400/4800
100	GE	11500	230/460
100		4600	2301
100	GE	11000	2300
100	GE	6900	2400/4160Y
100	GE	4160	240/120
100	GE	2400	120/240
100	Pitts.	2300	115/230
75	Pitts.	2400	120/240
75	Packard	460	150/230
75	GE	2400	600

MOTORS — MG SETS

— World's Largest Inventory —

We Stock 1200 Units 5 to 75 KVA

ELECTRIC EQUIPMENT COMPANY

ROCHESTER, N. Y.

PHONE: LD-65

COMPRESSORS: One Worthington 2 stage, 29/18½x21, 600 H.P. synchronous motor, 3 phase, 60 cycle, 440 volts, 180 RPM, 100 lbs. pressure, 3000 CFM, and one 22"x 13"x16", cap. 1750 CFM, 350 H.P., 225 RPM, synchronous motor, 3 phase, 60 cycle, 440 volt; both complete with all auxiliary equipment.

DIESEL MOTOR: 122 H.P. Caterpillar D13000 complete with clutch, V belt pulley, and spare parts.

DRAG SCRAPERS, CRESCENT BUCKETS: 1—Sauerman 2 yd. Drag Scraper outfit complete, without 75 H.P. motor. 1—Sauerman ¾ yd. capacity complete with 30 H.P. motor. 1—Sauerman 1 yd. capacity complete with diesel motor.

BOILER: 1—Erie City 150 H.P., ASME code, HRT, 150 lbs. pressure, 4" x 18 ft. tubes, complete with all fittings.

A. J. O'NEILL

Lansdowne, Pa.

Phila. Phones: MAdison 3-8300—3-8301

FOR SALE

IN CLEVELAND, OHIO

Used Allis-Chalmers Turbine Driven Air Compressors

One 23,000 CFM Capacity

One 40,000 CFM Capacity

Two used Ingersoll-Rand No. 40, Type APR Pumps with G.E. Group D, Class I Motors, Vertical Drive.

All equipment complete and in operating condition.

THE STANDARD OIL COMPANY (OHIO)

1401 Midland Bldg. — Cleveland 15, Ohio

R. L. Charles — MAin 1-7400

EQUIPMENT FOR SALE

Complete 120 Ton Frick Ice Mfg. Plant built 1949. 160 ton elec., 80 ton steam Ammonia Compressors. 225 HP B.W. Boilers, 160 lb. design. Air compressors, dehydrators, ammonia condensors, misc.

Inquiries invited. Power Engineer

FS-2468, POWER

520 N. Michigan Ave., Chicago 11, Ill.

1 BROS SUPER SPREAD STOKER

Model 10 complete with dump grates, fan, Minneapolis Honeywell controls, panel board and spare motor. Can be seen in operation until November 30th. This stoker has been in use for five years. Price $3000.00.

ITHACA LAUNDRIES INC.

102 Adams Street, Ithaca, N. Y.

MOTORS • GENERATORS

TRANSFORMERS

25 cy. 60 cy. D.C.

ALL VOLTAGES 1-1500 H.P.

NEW and REBUILT

BOUGHT and SOLD

ELECTRIC EQUIPMENT CO.

ROCHESTER 1, N. Y.

FOR SALE

TURBO GENERATORS

2 Sets . . . Consisting of:

2—CURTIS STEAM TURBINES—Each 4-Stage. 125 lbs. pressure. Serial Nos. 27819 and 27820, and

2—G. E. A-C GENERATORS—Type ATB-2. 375 KVA each. 3600 RPM. 300 KW. 361 AMP. PF 80%. 600 Volts. 60 Cycles. Serial Nos. 2006043 and 2006058.

J. C. BERKWIT & COMPANY

551 FIFTH AVE., NEW YORK CITY

MUrray Hill 2-2214

UNUSED CENTRIFUGAL PUMPS

2 Goulds 2" Fig. 3769 centrifugal pumps, 200 GPM at 70 ft. head at 1750 RPM. Bases and couplings for direct motor drive included. (Pumps in storage Jersey City.)

STOREY PUMP and EQUIPMENT COMPANY

510 Harbour Commission Bldg., Toronto 1, Canada

FOR SALE

Diesel Engine & Generator Sets

1—375 HP Worthington, 200 KW, GE Gen.
1—180 HP Worthington, 120 KW, GE Gen.
1— 45 HP GM Engine Gen. Set.
Switch Gear, Panel & Auxiliary Equip.

THE F. E. SCHUMACHER CO.

HARTVILLE, OHIO

An Investment!

Productive advertising is an INVESTMENT rather than an EXPENDITURE.

"Searchlight" advertisers almost invariably report prompt and satisfactory results.

BE CONVINCED — send us your advertisement TODAY.

Address

Classified Advertising Division

POWER

330 W. 42nd St., N. Y. 18, N. Y.

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500 (2)	2200	G.E.	900
500	2200	G.E.	450
450	440/220	Whse.	514
350	2200/440	G.E.	450
300	2200	G.E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	2200/550	G.E.	450
250	550/440	G.E.	1200
250	440	G.E.	600
200	440	G.E.	450
188	4000/2300	G.E.	1800
150	440/220	Whse.	600
150	440/220	Whse. (2)	1800
145	4000/2300	G.E.	1800
125	2200/440	G.E.	600
125	550/440	G.E.	1200
100	440/220	G.E.	600
100	440/220	G.E.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2300/400	G.E.	T4	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2300	El. Mchy.	Syn.	600
240	2300/440	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	T8	257
100	440/220	Whse.	G	1800
75	2300/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator dir. conn. to 50 hp, G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air
1—400 amp., 37000 V., G.E., Type FHKO-236 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	PT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
300	2200	G.E.	PT	3600
250	440	G.E.	IK	720
250	2200	Al. Chal	AR	1800
200	2200	G.E.	K	200
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
150	440	multi sp.	KT	1800/600
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2200/440	G.E.	K	1200
75 (5)	550	G.E.	KF	1800

A. C. GENERATORS

1—220 kva, 660 rpm, 2300/440/220 V., G.E.
1—275 kva, 1200 rpm, 460 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—187 kva, 1200 rpm, 440 V., Whse.
1—150 kva, 900 rpm, 480/240 v., G.E.
1—100 kva, 720 rpm, 440 V., G.E.
3—75 kva, 1800 rpm, 480/240 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	G.E.	CD	600
150	230 (2)	Whse.	SK	850
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—230 kw, 1200 rpm, 240 V., Whse., conn. to 350 hp, 2200 V., sq. cage.
1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—75/90 kw, 250 V., 1500 rpm, G.E. conn. to 135 hp, 440/220 V., sq. cage.
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/460 v., syn. motor.
1—65 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm, 440 V., synchronous.
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage.

TRANSFORMERS 60 CY.

3—500 kva, G.E., 4000—2300 V.
3—333 kva, G.E., 13,200—2300 V.
1—300 kva, Al. Chal. 4600/4160—240/120 V., 3 phase
3—300 kva, Whse., 13200—440 V.
3—250 kva, Whse., 11,000/22,000—2300 V.
3—250 kva, Whse., 2300—208 V.
3—200 kva, G.E., 13200—460/230 V.
3—200 kva, Whse., 2400—240/120 V.
3—75 kva, Moloney, 4150—240 V.
1—150 kva, Whse., 2400—240/480 V. (Pyranol)
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G.E., 4156—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
1—150 kva, Whse., SK, 13200-125/215 v., 3 ph.
3—75 kva, Whse., 2400—240/480 V.
6—50 kva, G.E., 2400—120/240 V.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

BOILER FOR SALE

One (1) New 200 H.P., 150 psig. Combustion Engineering H.R.T. boiler, complete with guyed steel stack and all equipment except grates. For brick setting and wood refuse firing. Stack 3'-2" diameter, 80' in length. One (1) 1½" Copes type BI boiler feedwater regulator, and one (1) Diamond Power Specialty "Straight-Line" soot Blower go with Boiler. Address inquiries to

ALMA DESK COMPANY
HIGH POINT, N. C.

SCOTCH BOILER

300 H.P. International Brady type, A.S.M.E., 150# pressure.

Immediate Delivery.

M. J. HUNT'S SONS
1620 N. Delaware Avenue
Philadelphia 25, Pa.

John H. Benson — Roy L. Wilimzig

MOTORS!! PUMPS!!

4—250 HP, 1170 RPM, Allis Chalmers Squirrel Cage Splash Proof, Frame 830DSWW, 3/60/2300. Will reconnect 220 or 440
1—200 HP, 600 RPM, GE, Slipring IM, Frame 17, 3/60/220/440
1—150 HP, 514 RPM, Westinghouse Slipring, Type HF, 3/60/220/440
3—75 HP, 900 RPM, Westinghouse Squirrel Cage, Type CS, Frame 752C, 3/60/220/440
1—1000 KVA—AC Generator Westinghouse, 3/60/2300 V., 720 RPM
1—1000 KVA Synchronous Condenser, 3/60/2300/4000, 600 RPM
2—24x24 Dayton Dowd CS24, 18.500 GPM, 18.5/35 FT. HD., 360/450 RPM

Phone, Write or Wire!

BENSON-WILIMZIG, INC.
formerly C & S Machinery Co.
1708 N. 8th St. St. Louis, Mo.
GA-4290

EXCELLENT POWER UNITS

2—125 KVA Westinghouse AC generators, 440 Volts, 277 RPM. Powered by 2 Bruce Mac Beth gas/gasoline engines.
1—150-HP, 225 RPM, Synchronous motor. Real Bargains.

A A A IRON CO.
Canton & Hawkins Sts., Dallas 1, Texas

BOILER

261 H.P. Farrar & Trefts 1943—125#, series 500 with Detroit stoker.

MALLORY MACHINERY CO.
525 W. Conway St., Balto. 30, Md.

DIESEL and GASOLINE ENGINES and GENERATOR SETS
1 to2000 K.W.

Transformers, Electrical Equipment
Sales, Purchases & Rentals
Nordberg Distributors
Dealer Territories open

MIDWEST UTILITIES POWER EQUIPMENT CORP.
1270 Augusta Blvd., Chicago, Illinois
EVerglade 4-4511

FOR SALE

One Fulton Iron Works 500 H.P., Class 5-G, 5 cylinder, 200 R.P.M. diesel engine Serial No. 1236, complete with auxiliaries and Westinghouse 3 phase, 60 cycle, 425 K.V.A. generator and direct connected exciter. This unit is now operating in our Liberal, Kansas, plant. It may be inspected at any time.

Bids should be mailed to

WESTERN LIGHT and TELEPHONE COMPANY, Inc.
P.O. Box 763 Great Bend, Kansas

BOILERS

10 to 5000 H.P.
Diesel, Steam Turbine, Engine

GENERATORS

Heavy Power Equipment
Industrial — Chemical Process Equipment.

NEW – RECONDITIONED – USED

DEAN G. STRICKLER & ASSOCIATES
1346 Connecticut Avenue, N.W.
Washington 6, D. C. • DuPont 3346

New "SEARCHLIGHT" Advertisements

received by December 10th appear in January issue, subject to limitations of space available.

Address copy to the Classified Advertising Division
POWER
330 West 42nd St., New York 36, N. Y.

DIESELS—FOR SALE

2—1250 HP, 4 cycle, 164 RPM MacIntosh-Seymour diesel engines driving 850 KW, 2 phase, 2300 volt, 60 cycle generators (can be rewound 3 phase). Units now in Central Station operation, probably available May 1952.

Contact Commissioner of Public Utilities
Rockville Centre, N. Y.

BOILERS

Four 250 H.P. Heating Boilers, practically new Pacific, Cada constructed, 15 lbs. W.P., complete with trim. Ray Oil Burners, Weston Pumps. Three Double Drum Heine 400 H.P., Cada constructed for 150 lbs. W.P. new tubes.

H. P. ALEXANDER BOILER & ENG. CO.
4700 Long Beach Ave., Los Angeles 58, Cal.

ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

Air Preheater Corp. ... *
Allen-Sherman-Hoff Co. ... Second Cover
Allis-Chalmers Mfg. Co. 22-23, 36, 46, 51, 55, 63, 66A, 66G
Allpax Company ... 226
American Blower Corp ... 229
American Brass Co. ... 149
American Chain & Cable Co. ... 204
American Chimney Corp. ... 290
American Coal Burner Co. ... 282
American District Steam Co. ... *
American Engineering Co. ... 185
American Locomotive Co. ... 258
American Manganese Steel Div. ... *
American Pulverizer Co. ... 181
Ames Iron Works ... 286
Anchor Packing Co. ... 207
Anderson Co., V. D. ... 271
Arkansas Fuel Oil Co. ... 190
Armstrong Cork Co. ... *
Armstrong Machine Works ... 147
Atlas Valve Co. ... 214

Babbitt Steam Specialty Co. ... 248
Babcock & Wilcox Co. ... 6-7, 157
Babcock & Wilcox Co. (Refractory Div.) ... *
Babcock & Wilcox Tube Co. ... *
Badger Mfg. Co. ... *
Bailey Meter Co. ... 12-13
Baltimore & Ohio Railroad ... *
Bartlett & Snow Co., C. O. ... *
Beaumont Birch Co. ... 246
Beico Industrial Equip. Div., Inc. ... 210
Bell & Gossett Co. ... 278
Belmont Packing & Rubber Co. ... 235
Betz Co., W. H. & L. D. ... 145
Biddle Co., James G. ... 228
Bigelow Co. ... 178
Bird-Archer Co. ... 267
Bituminous Coal Institute ... 48-49
Black, Sivalls & Bryson, Inc. ... 155
Blaw-Knox Construction Co. ... 247
Boiler Tube Co. of America ... 248
Bonney Forge & Tool Works ... *
Bothfield Refractories Co. ... 286
Brown-Boveri Corp. ... *
Buell Engineering Co. ... *
Buffalo Forge Co. ... 47
Buffalo Pumps, Inc. ... 284
Burgess-Manning Co. ... *
Bush Mfg Co. ... 208
Bussmann Mfg. Co. ... *
Butler Engineering Co. ... 284
Byers Co., A. M. ... 70

Carey Mfg. Co., Philip ... *
Cash Co., A. W. ... 270
Chapman Valve Mfg. Co. ... 177
Chase Brass & Copper Co. ... *
Chicago Metal Hose Corp. ... *
Chicago Pneumatic Tool Co. ... 283
Childers Mfg. Co. ... *
Cities Service Oil Co. ... 199
Clapp & Poliak ... 230
Clarage Fan Co. ... 268
Clark Mfg. Co. ... *
Clayton Mfg. Co. ... 186
Cleaver-Brooks Co. ... 264
Cleveland Worm & Gear Co. ... *
Const Metals, Inc. ... 251
Cochrane Corp. ... 242, 275
Coffin Jr. Co., J. S. ... 192
Combustion Engrg.-Superheater, Inc. ... 28-29
Coppus Engineering Co. ... *
Corning Glass Works ... 234
Crane Company ... 50, 163
Cyclotherm Corp. ... 183

Dart Union Co. ... *
Davis Regulator Co. ... 246
Dearborn Chemical Co. ... 239
DeLaval Separator Co. ... 193
DeLaval Steam Turbine Co. ... *
Detroit Stoker Co. ... 197
Diamond Power Specialty Corp. ... 8-9
Dixon Crucible Co., Joseph (Graphite Lubricant Div.) ... 216
Dodge Mfg. Corp. ... 262
Dowell, Inc. ... 175
Dravo Corp. ... 238
Dresser Industries, Inc. ... *
Drew & Co., Inc., E. F. ... 189

Eagle-Picher Co. ... *
Eastern Gas & Fuel Associates ... *
Economy Pumps, Inc. (Div. of Hamilton-Thomas Corp.) ... *
Edward Valves, Inc. ... 68-69
Eltetric Machinery Mfg. Co. ... 244
Electric Products Co. ... 234
Elgin Softener Corp. ... *
Elliott Co. ... 10-11
Elliott Co. (Lagonda Div.) ... 182
Ellison Draft Gage Co. ... 290
Engineer Co. ... *
Erie City Iron Works ... 195
Ernst Water Column & Gage Co. ... 290
Eutectic Welding Alloys Corp. ... *
Everlasting Valve Co. ... *

Fairfield Engineering Co. ... *
Farr Company ... *
Ferguson Co., H. K. ... 216
Fisher Governor Co. ... 58-59
Foster Engineering Co. ... 240
Foster Wheeler Corp. ... 20-21, 42-43
Foxboro Company ... 215
Frick Company ... 230
Fuller Company ... 265

Garlock Packing Co. ... 255
General Electric Co. (Apparatus Dept.) 16-17, 44-45, 52-53, 60-61, 66D-66E
Gifford-Wood Co. ... 250
Globe Steel Tubes Co. ... 269
Golden Anderson Valve Spec. Co. ... 190
Goodyear Tire & Rubber Co. ... *
Gorman-Rupp Co. ... *
Goulds Pumps, Inc. ... *
Graver Water Conditioning Co. ... 225
Green Fire Brick Co., A. P. ... 252
Green Fuel Economizer Co., Inc. ... 184
Grinnell Co. ... Third Cover
Griscom-Russell Co. ... *
Gruendler Crusher & Pulverizer Co. ... *
Gulf Oil Corp. ... 187
Gulf Refining Co. ... 187

Hagan Corp. ... *
Hall Laboratories ... 249
Hapman-Dutton Co. (Dutton Boiler Div.) ... 286
Harbison Walker Refractories Co. ... 245
Hays Corp. ... 256
Hendrick Mfg. Co. ... *
Henszey Co. ... 222
Hewitt-Robins, Inc. ... *
Heyl & Patterson, Inc. ... *
Hill Pump Valve Co. ... *
Hoffman Specialty Co. ... *

Illinois Water Treatment Co. ... *
Industrial Acoustics Co. ... 284
Industrial Sound Control Co. ... *
Infilco Inc. ... 6611
Ingersoll-Rand Co. ... 201
International Nickel Co. ... 254
Iron Fireman Mfg. Co. ... 269

Jefferson Union Co. ... 188
Jeffrey Mfg. Co. ... 231
Jenkins Bros. ... 152-153
Jerguson Gage & Valve Co. ... *
Johns-Manville ... 159
Johnson Service Co. ... *
Johnston Pump Co. ... 272
Jones Foundry & Machine Co., W. A. ... *
Joy Mfg. Co. ... 179

Keasbey & Mattison Co. ... 322
Kellogg Co., M. W. ... 219
Kennedy Valve Mfg. Co. ... 200
Kennedy-Van Saun Mfg. & Engrg. Corp. 30-31
Kewanee Boiler Corp. ... 248
Keystone Coal Buyers Manual ... 281
Klipfel Valves, Inc. (Div. of Hamilton-Thomas Corp.) ... *
Koppers Co., Inc. (Coupling Dept.) ... *
Kuljian Corp. ... *

Ladish Co. ... *
Leeds & Northrup Co. ... *
Leffel & Co., James ... 238
Leslie Co. ... *
Link-Belt Co. ... 1
Littleford Bros., Inc. (Gen. Div.) ... *
Lockett & Co., A. M. ... *
Loftus Corp., Peter F. ... 202
Lubriplate Div. Fiske Bros. Refining Co. ... 227
Lukens Steel Co. ... 287
Lumnite Div. Universal Atlas Cement Co. 266
Lunkenheimer Co. ... 211

Magnolia Metal Co. ... *
Manheim Mfg. & Belting Co. ... 253
Manning, Maxwell & Moore, Inc. ... 221
Manzel, Inc. ... *
Marley Company ... *
Marsh Instrument Co. ... 274
Mason-Neilan Regulator Co. ... 218
McGraw-Hill Book Co. ... 248, 288
Mercoid Company ... 248

Midwest Piping & Supply Co. 277
Minneapolis-Honeywell Reg. Co., Industrial Div. 64-65
Mitchell & Co., Inc. W. K. 191
Monsanto Chemical Co. 235
Mundet Cork Corp. 212
Murray Mfg. Co., D. J. ..... *
Murray Iron Works Co. 224

National Airoil Burner Co., Inc. 220
National Aluminate Corp. 151
National Boiler Protector Co. 242
National Conveyors Co., Inc. ..... *
National Conveyor & Supply Co. 236
National Tube Co. ..... *
National Valve & Mfg. Co. 62
Niagara Blower Co. 198
Nicholson & Co., W. H. 222
Nordberg Mfg. Co. 213
Northern Equipment Co. 18-19

Oakite Products, Inc. 236
Owen-Illinois Glass Co. (Kaylo Div.) 257

Pabco Products, Inc. 194
Pangborn Corp. 246
Peabody Engineering Co. ..... *
Peerless Pump Div. (Food Machy. & Chem. Corp.) ..... *
Penberthy Injector Co. 280
Pennsylvania Railroad 261
Permutit Company ..... *
Perolin Co., Inc. 232
Petro-Chem. Development Co., Inc. ..... *
Philadelphia Gear Works 273
Pittsburgh Piping & Equipment Co. 289
Powell Co., Wm. 203
Powers Regulator Co. 137
Preferred Utilities Mfg. Co. ..... *
Pritchard & Co., J. F. 279

Read-Standard Corp. ..... *
Reading, Pratt & Cady Div. 204
Refinite Corp. ..... *
Republic Flow Meters Co. 66B-66C
Republic Rubber Div. Lee Rubber & Tire Corp. ..... *
Republic Steel Corp. ..... *
Research Corp. 260
Revere Copper & Brass, Inc. 165
Rhoads & Sons, J. E. ..... *
Ric-Wil Co. 223
Riley Stoker Corp. 112-113
Rohm & Haas Co. (Resinous Prod. Div.) 161
Roots-Connersville Blower Corp. ..... *
Roto Div. of Elliott Co. ..... *

Sarco Company 114
Schaub Engrg. Co., Fred H. ..... *
Schramm, Inc. ..... *
Servel, Inc. ..... *
Sier-Bath Gear & Pump Co. ..... *
Simplex Valve & Meter Co. ..... *
Sinclair Refining Co. 56-57
Skinner Engine Co. ..... *
Smith Refractories Inc., Sanford 280
Socony-Vacuum Oil Co. ..... *
Spence Engineering Co., Inc. 266
Springfield Boiler Co. 35
Squires Co., C. E. 169
Standard Oil Co. of Indiana 33-34
Steel & Tubes Div. ..... *
Sterling Engrg. & Mfg. Corp. 290
Sticht Co., Herman H. 290
Stickle Steam Specialties Co. ..... *
Stock Equipment Co. 217
Stone & Webster Engrg. Co. 205
Strong, Carlisle & Hammond Co. 196
Sun Oil Company ..... *

Superior Combustion Industries 173
Swartwout Company 167

Taylor Forge & Pipe Works 285
Taylor Instrument Co's 243
Taylor & Co., W. A. ..... *
Terry Steam Turbine Co. ..... *
Texas Company 4
Tidewater Associated Oil Co. 170
Tilco-Fin Div-Kentile, Inc. 176
Todd Shipyards Corp. (Combustion Equip. Div.) 242
Tri-Lok Co. 238
Troy Engine & Machine Co. ..... *

Union Asbestos & Rubber Co. 259
Union Iron Works ..... *
United Cooling Tower Co. ..... *
United States Gasket Co. 180
U.S. Steel Corp. ..... *

Viking Pump Co. ..... *
Vogt Machine Co., Henry 237
Vulcan Soot Blower Corp. 14-15

Wallace & Tiernan Products, Inc. ..... *
Walworth Company ..... Back Cover
Warren Steam Pump Co. ..... *
Water Cooling Equipment Co. ..... *
Watson-Stillman Co. 241
Western Chemical Co. ..... *
Western Precipitation Corp. 143
Westinghouse Electric Corp. 32, 40-41
Westinghouse Electric Corp. (Sturtevant Div.) 24-25
Wheeler Mfg. Co., C. H. 291
Where to Buy 290
Wickes Boiler Co. ..... *
Wiedeke Co., Gustav 226
Wilmot Engineering Corp. ..... *
Wilson Engineering Corp. ..... *
Wing Mfg. Co., L. J. 282
Worthington Pump & Machy. Corp. 2, 37, 38, 39, 54, 66, 66F

Yarnall-Waring Co. 26-27, 139
Youngstown Sheet & Tube Co. 233

Zallea Bros. 263

Professional Services **288**

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT
Positions Vacant 292, 293
Positions Wanted 292
Selling Opportunities Wanted 292
Employment Agencies 293

SPECIAL SERVICES
Repairing 292

BUSINESS OPPORTUNITIES
Offered 292

EQUIPMENT
(Used or Surplus New)
For Sale 292-319

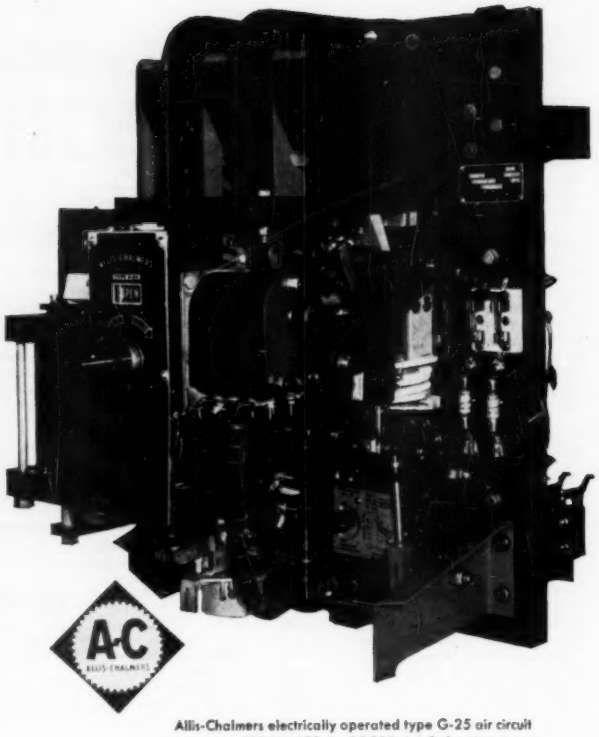
WANTED
Equipment 292

ADVERTISERS INDEX
AAA Iron Co. 319
Alexander Boiler & Eng. Co. 319
Aljon Electric Diesel Co. 313
Allied Electric & Machy. Co. 292
Alma Desk Company 319
American Air Compressor Corp. 306
Andren-Myerson Co. 315, 317
ARG Chemical Machinery 292
Arrow Transformer Co., Inc. 317
Automatic Combustion Equipment Co., Inc. 317
Bauer, L. W. 292
Belyea Co., Inc. 296, 297
Benson-Williamsig, Inc. 319
Berkwit & Co. 318
Bissell, Benjamin W. 316
Boston Metals Co., The 305
Boswick Electric Co. 308
Brew, Woltman & Co., Inc. 311
Bromley Electric Engineering Co. 292
Castle Co., James T. 317
Chicago Electric Co. 302
Donoghue, Stephen S. 292
Douglass Co., Stephen A. 311
Duquesne Electric & Mfg. Co. 307
Ebasco Services Inc. 310
Electric Equipment Co. 292, 303, 318
Electric Generator & Motor Co. 306
Electric Service Co., Inc. 314
Ellis Co., A. Lee 307
Empire Electric Co., Inc. 306, 310
Erie Electric Co., Inc. 314
Ferguson Co., Inc., The H. K. 293
Glow Electric Machinery Co. 312
H & P Machinery Co. 314
Hagan Corporation 293
Hall & Co., Stephen 319
Hanson, Martin J. 314
Heller Co., Albert 316
Hemphill & Co., J. L. 315
Howe Brothers 310
Hunt's Sons, M. J. 319
International Fermont Machinery Co., Inc. 316
International Power Machinery Co. 312
Ithaca Laundries, Inc. 318
Jennings, Jira T. 293
Johnson & Assoc., H. Blane 311
Kane McGuire Co. 308
Keystone Power Plant Equipment Co. 315
Kirk Co., Wallace E. 306
Land Inc., J. L. 299
Leifke, R. O. 313
Luria Brothers Co., Inc. 316
MacCabe Co., T. B. 317
Mallory Machinery Co. 319
Merrill & Company 312
Midwest Utilities Power Equip. Corp. 319
Mississippi Valley Equipment Co. 306
Moorhead Electrical Machinery Co. 311
Morse Bros. Machinery Co. 308
Moulton, Wm. C. 307
National Metal & Steel Corp. 317
Neiswander, Robert L. 316
New England Boiler Setting Co. 292
Newman & Co., Inc. 314
Northrop Aircraft Inc. 293
O'Brien Machinery Co. 300
O'Neill, A. J. 318
Penn Machinery Co. 311
Pierce Cable Co. 292
Pinedale Power & Light Co., Inc. 292
Power Equipment Co. 310
Power Plant Equipment Co., Inc. 309
Preferred Electric Motors Inc. 313
Rearick, Charles B. 311
Rockville Centre, Village of 319
Sandman Electric Co., Inc. 314
Schoonmaker Co., Inc., A. G. 309
Schrafft & Sons Corp. 312
Schumacher Co., The F. E. 318
Solvay Process Div., Allied Chemical & Dye Corp. 293
South Texas Machinery Co., Inc. 312
Specialties Service & Engineering Co. 315
Standard Oil Cor., The 318
Storey Pump & Equipment Co. 318
Strickler & Assoc., Dean G. 319
Tampa Armature Works, Inc. 304
Thompson Co., Inc., J. Parker 316
Tippins Machinery Co. 307
Universal Wire & Cable Co. 314
Utility Equipment & Construction Co. 316
Utilities Machinery Corp. 301
Volland Electric Co. 313
Wagner Co., Arthur 298
Walker & Collins 292
Weaver, Charles 294, 295
Western Light & Telephone Co., Inc. 319
Wisconsin, Michigan Power Co. 316
Woodworth Engineering Co., H. A. 312

TOUGH DUTY FOR A MOUNTING PANEL

...why Allis-Chalmers mounts this G-25 Breaker on

K&M EBONIZED ASBESTOS



Allis-Chalmers electrically operated type G-25 air circuit breaker; 600 V., 600 A., 25,000 A-I-C. Breaker components mounted on panel of K&M Ebonized Asbestos.

A 600 Amp. circuit breaker is heavy machinery—it has to be for dependable operation. To mount their popular G-25 Breaker, Allis-Chalmers uses K&M Ebonized Asbestos. Here are the reasons:

THE HIGH MECHANICAL STRENGTH of K&M Ebonized Asbestos withstands the structural forces of heavy breaker operations—helps assure that components will *stay put* through the busiest duty cycles.

EXCEPTIONAL DIELECTRIC STRENGTH effectively insulates operating components. And K&M Ebonized is completely non-magnetic—is not affected by electrical stresses.

RELATIVELY LIGHT IN WEIGHT, K&M Ebonized Asbestos can be handled easily; makes a mounting panel that is extremely strong without being unnecessarily heavy or bulky.

EASY TO CUT AND TO DRILL, Ebonized Asbestos saves fabrication time and costs; will not chip or fracture while being cut or drilled.

APPEARANCE THAT HELPS SELL! K&M Ebonized Asbestos is furnished with a smooth-sanded finish, lacquered with deep-black switchboard lacquer. This attractive, durable surface adds a sales "plus" to any unit!

Allis-Chalmers is typical of the many progressive electrical equipment manufacturers who have found K&M Ebonized Asbestos the answer to their needs for panel mountings, test tables, bus bar supports, switchgear compartment linings, and many other applications. To find out how it can fill your needs, write us—without obligation, of course.

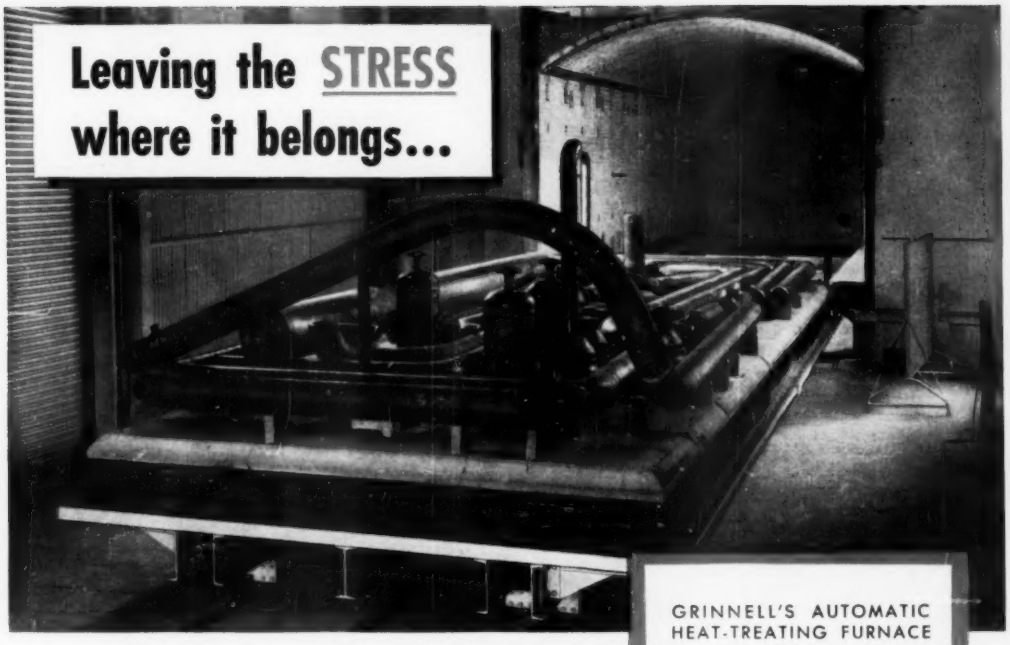
K&M best in asbestos

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

In Canada: ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG, VANCOUVER

Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

Leaving the STRESS where it belongs...



Stress relieving prefabricated piping with highly developed equipment and special techniques is one reason why exacting specifications are met with

GRINNELL PREFABRICATED PIPING

Grinnell received an order recently for stress relieving prefabricated piping to these specifications:—

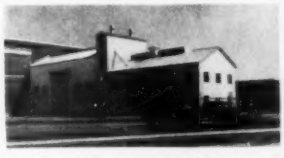
> "All fabricated pieces shall be normalized and drawn by heating to a uniform temperature of 1700°F (plus or minus 25°F). This temperature shall be maintained on a basis of one-half hour for each quarter inch of wall thickness of the heaviest pipe in the furnace charge followed by air cooling not less than 600°F. All pieces shall then be reheated to 1425°F and held at temperatures as above. In no case shall the time be less than 2 hours . . . Cool at a controlled rate not to exceed 200°F per hour until 600°F is reached . . ."

Grinnell, of course, met these specifications precisely. In fact, fabricating industrial piping today demands the *maximum* in versatility and precision.

Modern power plants, for example, need piping of heavy cross-sectional area and definite alloy composition to provide high temperature stability, resistance to creep and graphitization. Chemical and oil refining processes, on the other hand, must have piping of high chrome alloy to impart strength at high temperatures, resist corrosion, withstand impacts at low temperatures. Heat-treating often is the only answer — either to restore properties affected during fabrication, or improve original properties.

GRINNELL'S AUTOMATIC HEAT-TREATING FURNACE

performs with positive efficiency. This versatile stress-relieving unit, measuring 12 by 12 by 40 feet and using gas or oil or both as fuel, was designed to give full program control for the entire range of working temperatures. It provides instrument control of rate of rise in temperature of the charge, length of time for holding at the predetermined temperature level, and cooling rate. Two recording controllers are provided for the furnace and a separate 6-point recorder registers the temperatures of the charge simultaneously during the treating cycle.



Exterior View of Building

In heat-treating, as in everything else for piping, Grinnell has the experience and the costly equipment to fully protect large piping expenditures. That is why it will always pay you to call on Grinnell for *all* of your piping needs.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

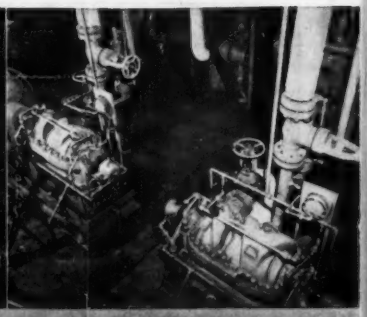
pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

WALWORTH *Pressure Seal* VALVES

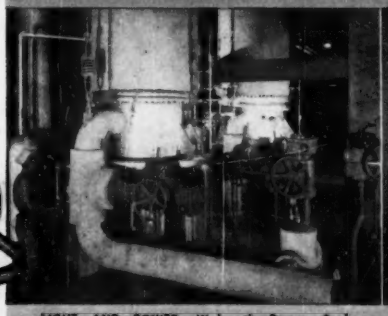
For high-pressure, high-temperature services

Walworth 6-inch Series 900 Pressure-Seal Gate Valve with Series 1500 Y-type Globe Valve on the by-pass.

CHEMICAL PLANT: Walworth Pressure-Seal Valves in the pressure reducing station of a chemical plant.



MARINE: Walworth Pressure-Seal Valves aboard the S.S. "Wilfred Sykes"—largest Great Lakes ore carrier.



LIGHT AND POWER: Walworth Pressure-Seal Valves equipped with motor operators, in an eastern public utility plant.

PAPER MILL: Fabricated header with 8-inch Series 600 Pressure-Seal Y-Globe Non-Return Valves and Series 600 Pressure-Seal Gate Valve.

Series 1500 Cast Steel Y-type Globe and Angle Valves in sizes ¼ to 2 inches.

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. The bonnet joint of the Walworth Pressure-Seal Valve is permanently tight because there is no dependency on the ability of any component part of the joint to resist creep during long exposure to high temperature. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved flexible disc design maintains seat tightness, even when the valve body is distorted by pipeline stresses or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, 1500, 2500 and in a wide range of sizes and types. For further information, write for Circular 116.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD